VOLUME 53 JUNE, 1945 NUMBER 6

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

The AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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American Roentgen Ray Society · *Forty-fifth Annual Meeting* (1945)
(Canceled)

American Radium Society · *Twenty-eighth Annual Meeting* (1945)
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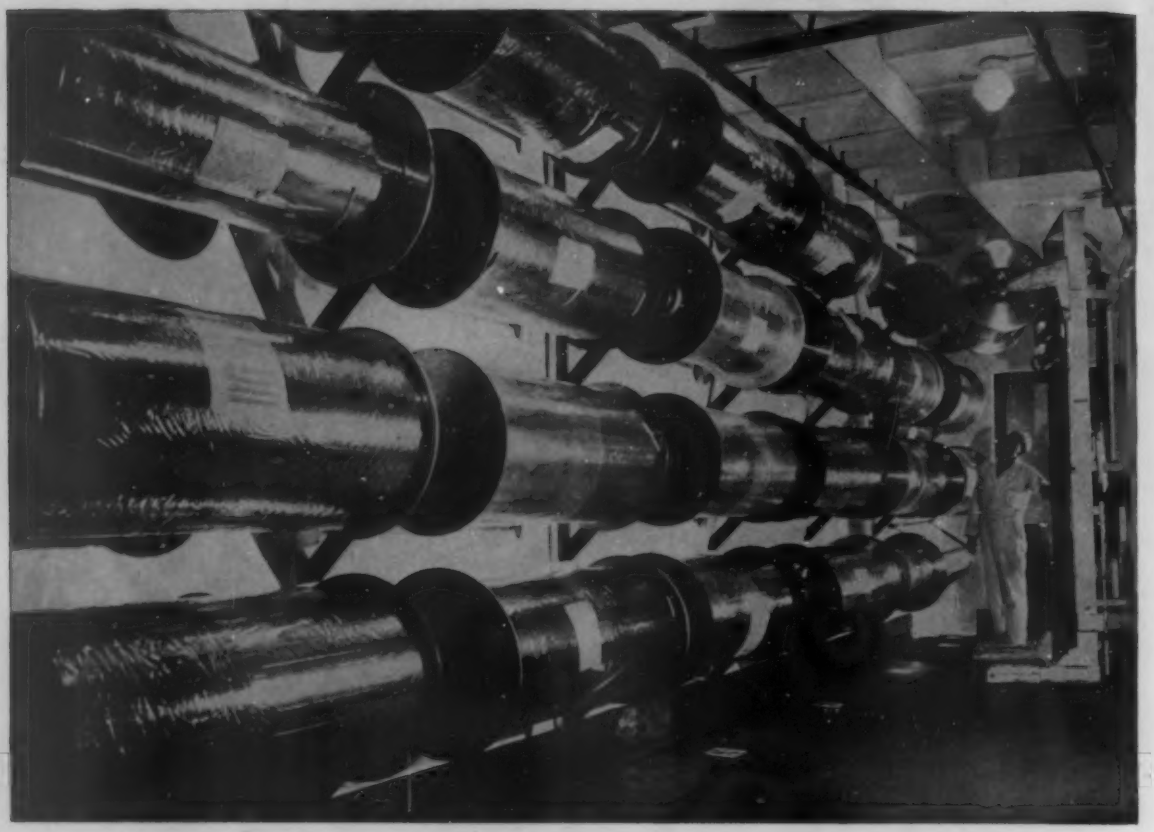
ANNUAL SUBSCRIPTION, $10.00 SINGLE NUMBER $1.50

INDEX NUMBER

JUL 18 1945

(No. 6 of a series on the manufacture of Du Pont Safety X-ray Film)



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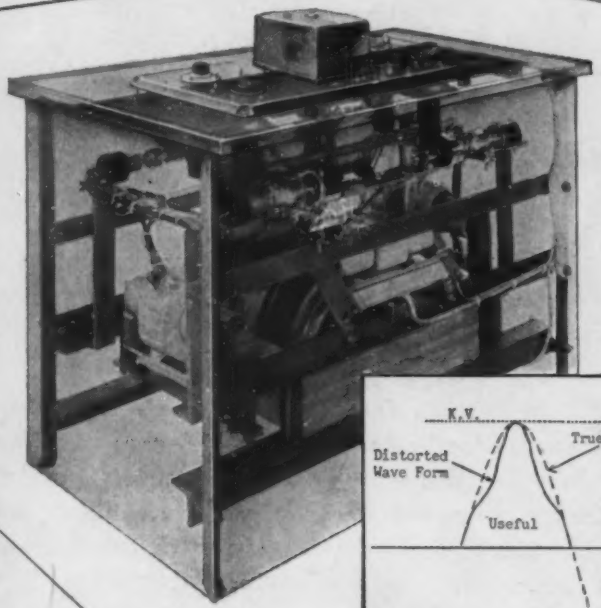

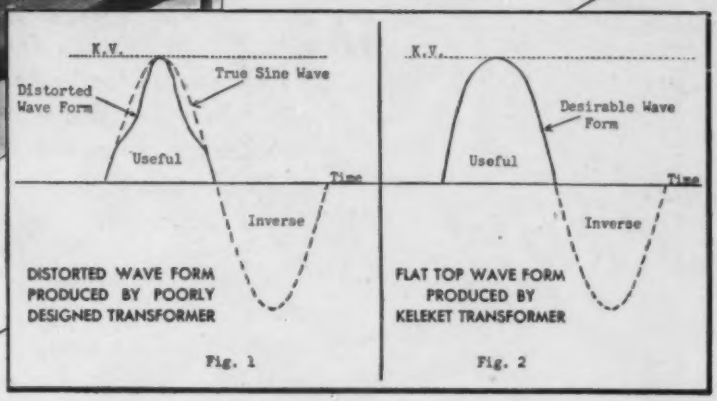

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Manuscripts offered for publication and other correspondence relating to the editorial management and books for review should be sent to Dr. Lawrence Reynolds, Editor, 110 Professional Building, Detroit 1, Michigan. Contributions may be sent in foreign languages and will be translated if found acceptable. Original articles are published only with the understanding that they are contributed exclusively to this JOURNAL.

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Entered as second-class matter February 10, 1930, at the postoffice at Springfield, Illinois, and Menasha, Wisconsin, under the Act of March 3, 1879. Accepted for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph 4, section 438, P.L. and R. authorized February 10, 1930. Delivery is not guaranteed. Replacements are not guaranteed nor promised, but will be attempted if extra single copies are available and only if requested within 30 days from first of month following publication (17th of month) for domestic subscribers and 60 days for foreign subscribers. A 30 day notice of a change of address is requested. When ordering a change of address, please give to the Publisher both the old and new address.

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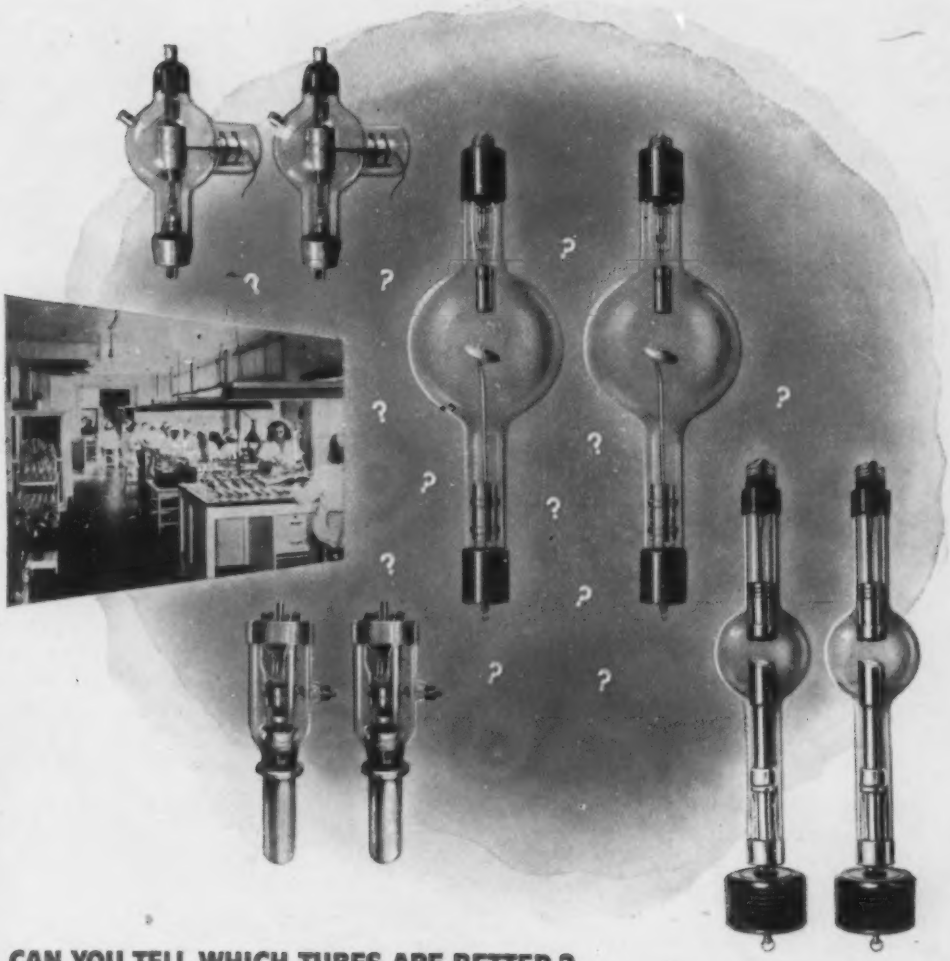

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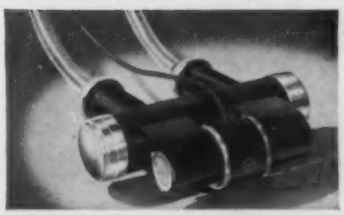

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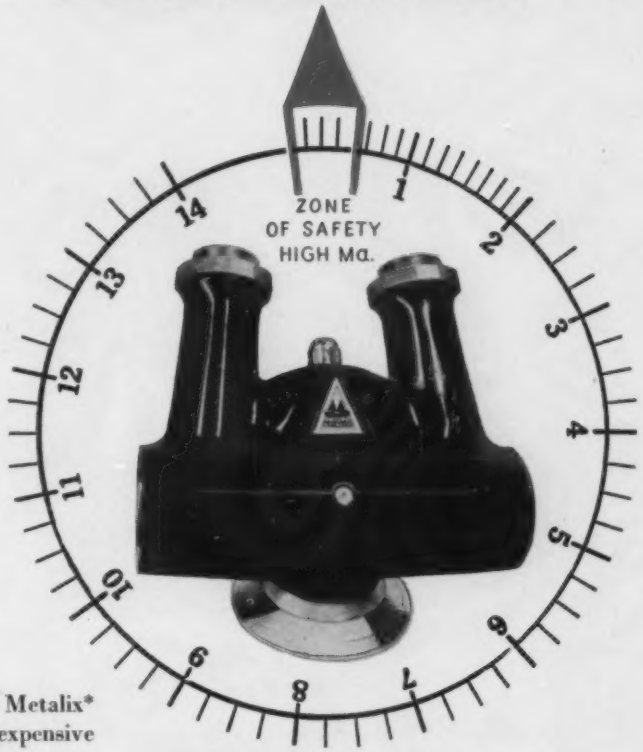

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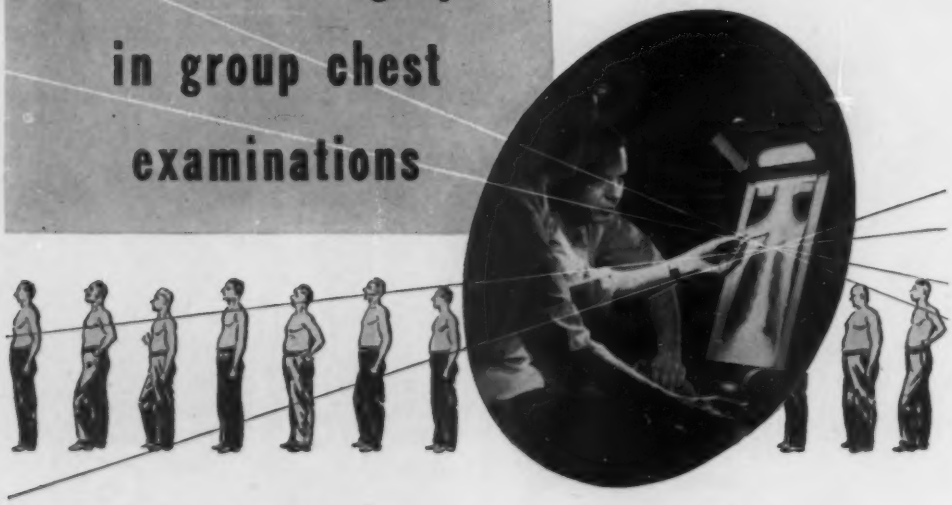

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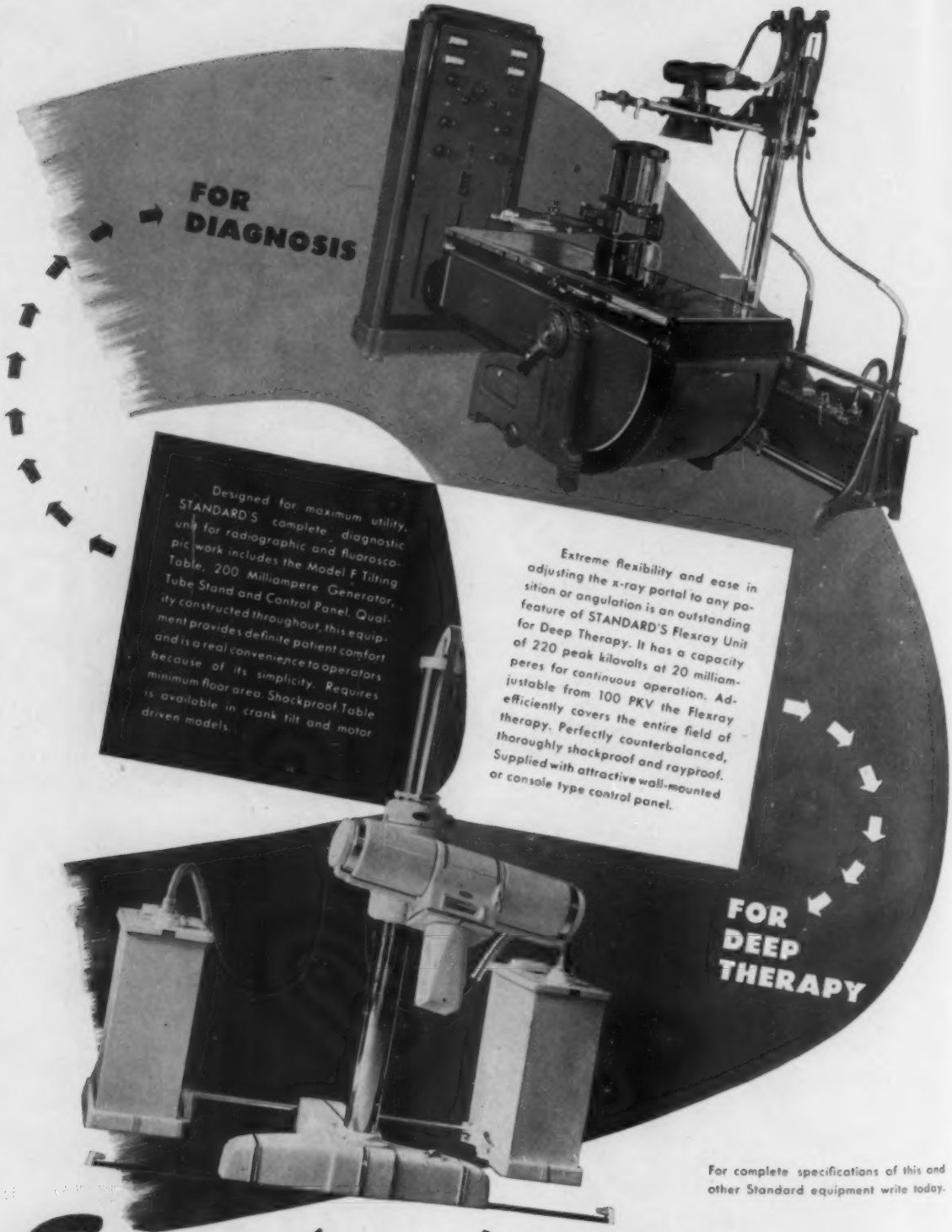
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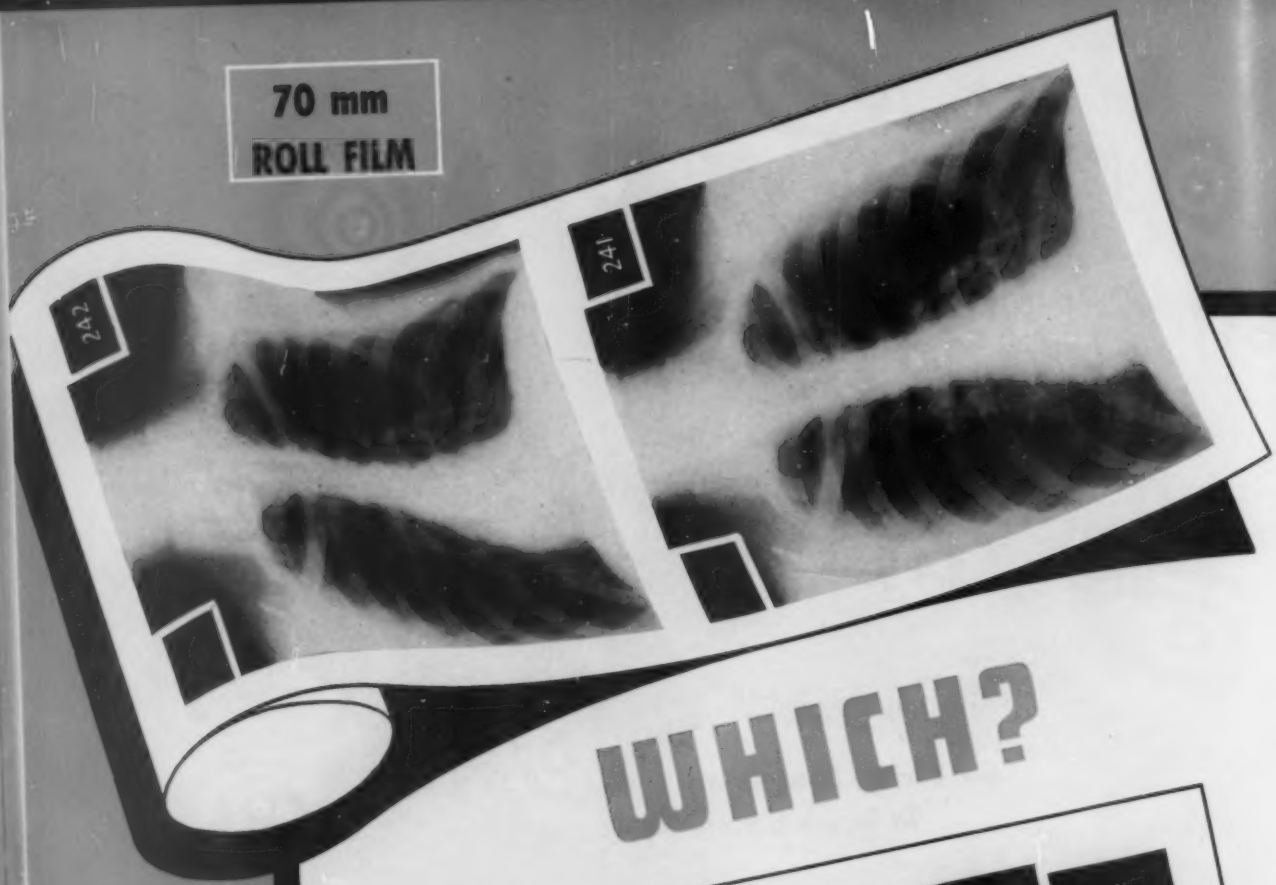

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 53 JUNE, 1945 No. 6

THE ROENTGEN EXAMINATION OF THE URINARY TRACT

WITH SPECIAL REFERENCE TO METHODS OF EXAMINATION AND FINDINGS IN INDIVIDUALS WITH TESTICULAR TUMORS*

By LIEUTENANT COLONEL JOSEPH C. BELL, MAJOR GILBERT W. HEUBLEIN, *and* MAJOR HOWARD J. HAMMER

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UROLOGICAL opinion concerning the importance and value of the various methods of roentgen investigation in urinary tract disease is of importance to all roentgenologists. Randall[8] in the *Journal of Urology* stresses the importance of intravenous urography in the demonstration of otherwise occult metastases from testicular tumors. He also emphasizes the importance of this examination in determining the prognosis in such cases.

One of us (H.J.H.) a urologist† is quoted as follows:

Of utmost importance both to the urologist and the patient is a thorough and accurate roentgenological examination by means of which the urologist is aided in arriving at an accurate diagnosis, after which the indicated treatment may promptly be initiated. Close collaboration between the urologist and radiologist will benefit all concerned. As Pendergrass has pointed out, individual ability to detect minute morphological changes in roentgenograms is subject to error. Skilled interpretation is the result of wide experience gained by those examiners who weigh clinical and laboratory data and follow carefully the progress of their patients.

The technical aspects of the roentgen examination as well as accurate interpretation of findings are of major importance. The urologist who has the time, training and experience essential in this phase of urologic diagnosis, is the rare exception.

While the relative merits of excretory and retrograde urography have been subjected to endless series of critical appraisals in medical literature, it is the common belief of most urologists that the two methods are complementary.

The value and accuracy of the roentgen examination in the diagnosis of the many diseases and anomalies of the urinary tract are now generally recognized by all members of the medical profession.

This presentation will be limited chiefly to a discussion of some of the technical aspects of the roentgen examination of the

* From the Sections of Radiology and Urology of the Percy Jones General and Convalescent Hospital, Battle Creek, Mich. Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24–29, 1944.

† Chief of the Section of Urology of the Percy Jones General and Convalescent Hospital.

urinary tract together with the roentgen manifestations in a few diseases that affect it. Our methods are not original, but are those, or parts of those, long employed by other workers in this field of diagnosis. We have attempted to so plan our examination that good technical results may be had and accurate diagnoses arrived at with the least essential expenditure of time and materials.

METHOD OF EXAMINATION

Intravenous Urography. The first essential is the proper selection of patients to be examined. A definite contraindication to this type of examination is advanced renal disease with marked impairment of renal function. Likewise patients in advanced stages of some other diseases are unsuitable for this form of investigation, as are those in shock, coma and in extremis.

Sensitivity to the contrast medium to be injected is also a contraindication. At the Percy Jones General and Convalescent Hospital we test for sensitivity to diodrast by the method described by Archer and Harris,[1] two drops of diodrast being placed in the conjunctival sac and the eye examined three to five minutes later. Normally there is no reaction to the diodrast. Evidence of sensitivity is exhibited by congestion of the conjunctival vessels. If slight or very moderate congestion is noted, however, the intravenous injection is made, but with great caution. Marked congestion is considered a contraindication, and in our hospital other means of investigation are resorted to in these individuals, who are very few in number. In approximately 600 examinations during the past fifteen months, using the above test as a guide, we have had no reactions except those of the mildest type.

In a personal communication, Archer states that he and his associates have examined 3 cases of severe asthma, in each of whom the sensitivity test to diodrast was entirely negative, but in all of whom severe and quite alarming reactions took place. Fortunately all recovered. It is Archer's opinion that a definite history of asthma should be considered a contraindication to this type of examination even when the sensitivity test is negative.

It should be recalled that, according to Pendergrass, *et al.*,[7] the incidence of fatal reactions from intravenous urography in a series of 661,800 examinations was 0.0039 per cent. In other words, this represents approximately 3.9 deaths per 100,000 examinations done by roentgenologists and urologists throughout the United States and Canada.

The preparation of our patients consists of a laxative, preferably castor oil or compound licorice powder, before the evening meal prior to the morning of the examination. No food or fluid is taken after midnight and a cleansing enema is given one hour before the examination. In some cases the injection of one ampule of pitressin precedes the enema by thirty minutes, but we question the necessity and wisdom of the latter in most cases.

Prior to the injection of the particular contrast medium to be used, a preliminary roentgenogram of the entire area of the urinary tract is always made. The injection is done by one of the medical officers of the Roentgen Department who assumes responsibility of observing the patient and directing the technique employed in each individual case. This is not an examination in which any routine procedure is satisfactory. If roentgenograms are routinely made at stated intervals over a long period of time, much time and material are wasted in a large percentage of cases. If, however, few roentgenograms are secured and the examination covers only a short interval much valuable information is lost.

We inject the contrast medium slowly, usually requiring from three to four minutes. A roentgenogram of the entire urinary tract is made five minutes after the injection is completed and developed immediately. Pressure is made over the promontory of the sacrum using a compression band, the pressure being localized by placing a child's football or a basketball bladder above the pubic arch beneath the com-

pression band. In the large majority of cases the ureters are blocked at the pelvic inlet by this method. The compression is maintained for five minutes after which stereoscopic roentgenograms of the proximal half of the urinary tract area are made using 10 by 12 inch films. Preparation is then made for a 14 by 17 inch film and the exposure made immediately after releasing the pressure. In this roentgenogram *the entire tract is usually most satisfactorily visualized, especially the distal halves of the ureters* (Fig. 1). If there is the possibility of a stone in the lower third of either ureter or some abnormality of the bladder, we then make 8 by 10 inch stereoscopic roentgenograms of this region using a transverse shift of the tube. At about this time the roentgenogram made at the five minute period may be seen and from this examination further requirements in the individual case can usually be determined. If normal excretion and drainage are taking place on each side a roentgenogram is then made with the patient upright and the examination terminated.

If, however, function is impaired or even apparently entirely absent on one or both sides, roentgenograms of the entire tract are made, usually at fifteen minute intervals for the first hour after the injection, or until satisfactory visualization takes place. Each of these roentgenograms is examined immediately after it is developed and fixed, and further roentgenographic requirements thus determined. If satisfactory visualization of one or both sides has not taken place during the first hour, roentgenograms are then made at thirty minute intervals until satisfactory filling has taken place. If there is no evidence of any excretion within two and one-half hours following the injection the examination is terminated. It is not uncommon in an apparently nonfunctioning kidney first to visualize the structures on the affected side as late as two or even two and one-half hours after the injection and as a result to obtain invaluable diagnostic data (Fig. 2).

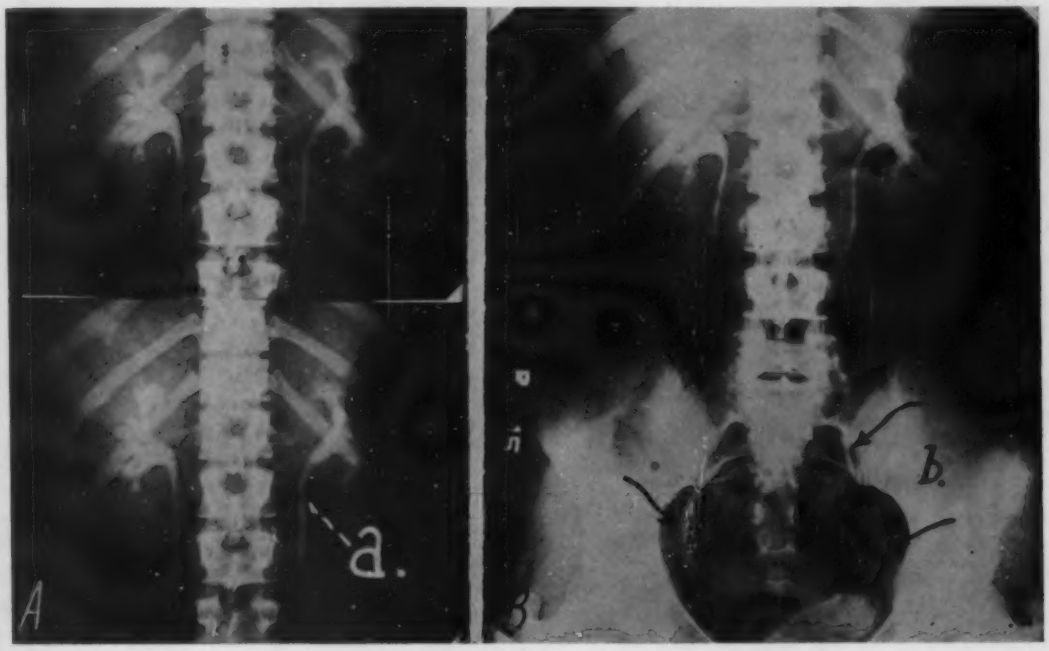

Fig. 1. Normal intravenous urogram. *A*, stereoscopic views of upper collecting system made during compression are shown at *a*. *B*, at *b*, shows very satisfactory filling of the lower ureters usually seen in urograms made immediately after removal of compression.

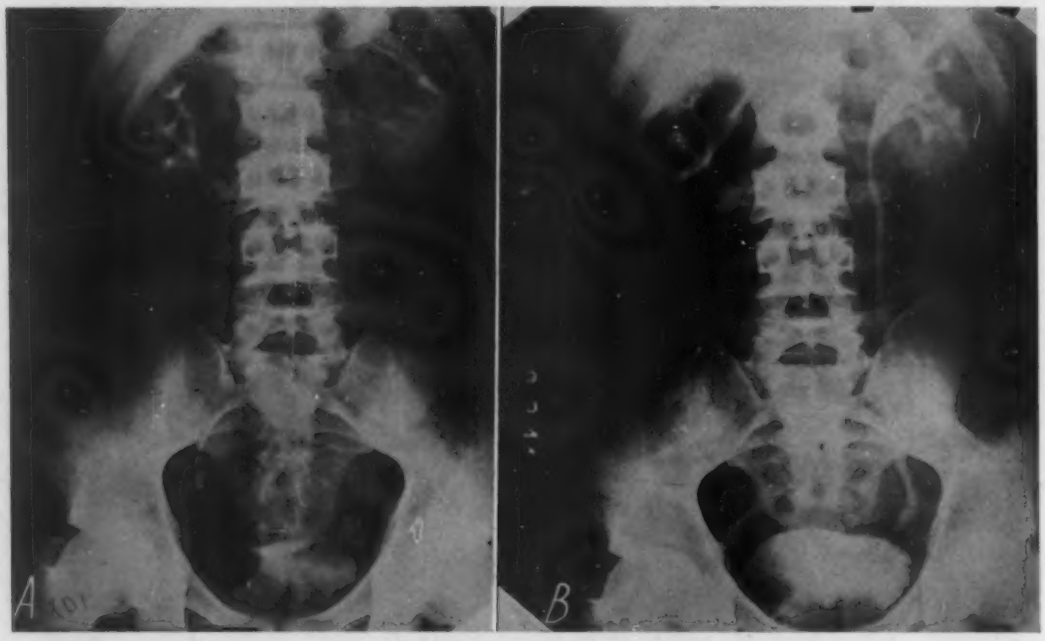

FIG. 2. Tiny stone at junction of left ureter with bladder. *A* shows normal function and drainage of right kidney and ureter. Almost no evidence of opaque material seen on the left. *B* was made forty-five minutes after injection. Almost complete emptying of pelvis and ureter on the right. Interference with drainage of left ureter at junction with bladder, dilatation of ureter, pelvis and minor calices are well shown. Stone passed spontaneously twenty-four hours later. Urinary tract to be re-examined later, but it will undoubtedly be normal.

Our technique of intravenous urography is graphically illustrated in Figure 3. The position of the patient, roentgen tube, Potter-Bucky diaphragm, compression band and cassette are shown, together with the time interval between exposures. In practice, compression is rarely maintained for more than from five to seven minutes.

Accurate interpretation of findings in intravenous urography requires a sound basic knowledge of urinary tract morphology and physiology in health and disease and the corresponding roentgen manifestations. Further requirements are accurate observation, experience and sound judgment. The roentgenologist in his interpretation must always keep in mind the limitations of the diagnostic aid employed. He must not draw conclusions unjustified by his findings and must always be ready to work with the referring physician, sharing responsibility in arriving at the proper diagnosis.

Retrograde Urography. Retrograde urography continues to have an important place in the study of disturbances of the urinary tract. There is no conflict between the retrograde and intravenous methods. Each has advantages in certain conditions and one supplements the other in many cases. In retrograde urography we believe that best results are secured when the radiologist assumes the direction of the roentgenographic phase of the examination, and the interpretation of the roentgen findings is his responsibility.

The Use and Value of the Roentgenoscope in Retrograde Urography. During the past year an increasing number of our retrograde urograms have been done under roentgenoscopic guidance. This was begun in a case with marked pelvic dilatation where the urologist was anxious to secure complete filling. The results were so satisfactory and the method so simple that more and more cases have been done in this manner.

The equipment required is only that already available in most modern hospitals. In our hospital, after ureteral catheterization in the urological section on the sixth floor, the patient is brought to the roentgenographic department on the first floor. He is then placed on the horizontal roentgenographic-roentgenoscopic table, the eyes of the roentgenologist having been accommodated in the meantime.

The contrast medium is introduced by the urologist with the aid of roentgenoscopic guidance by the radiologist. Care is taken to obtain complete filling without over-distention by careful observation of the screen image and the patient's reaction to the injection. By means of a spot film device on our machine, irritability of any part of the tract observed can readily be recorded with repeated exposures. Similarly any other abnormality seen can instantaneously be recorded. After completing the injection, stereoscopic roentgenograms of the entire tract are made in the conventional manner and frequently a lateral view with the side under suspicion nearest the cassette.

The following history and findings in the case shown in Figures 4 and 5 illustrate the importance and value of the above type of examination.

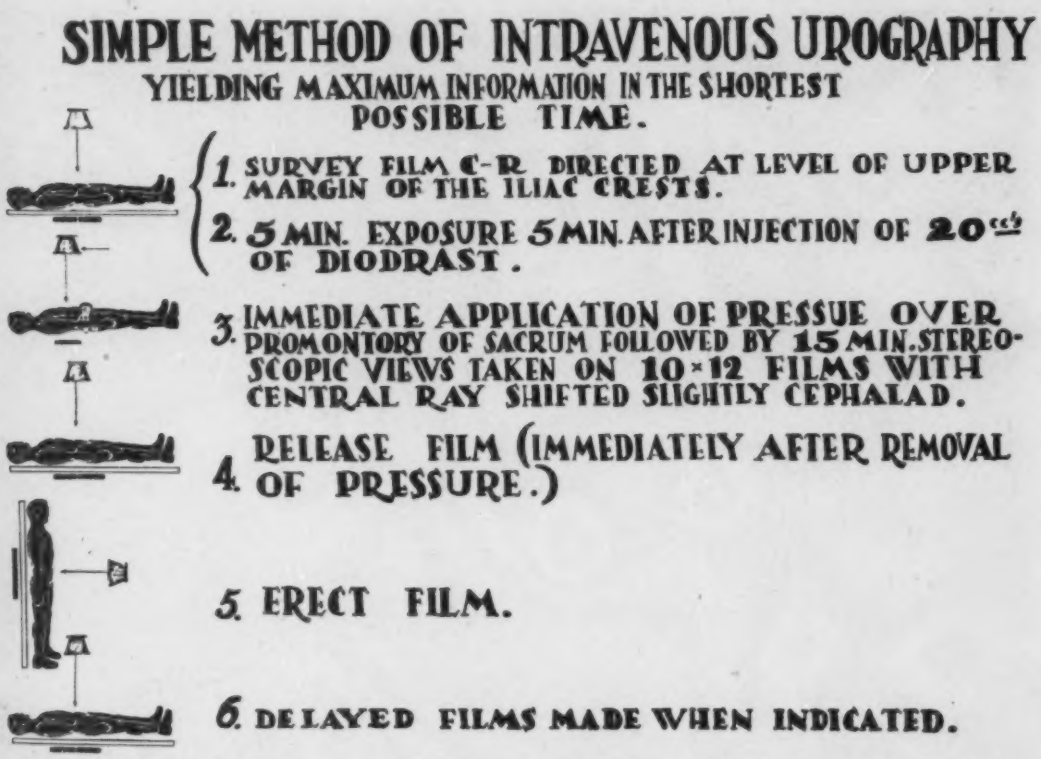
SIMPLE METHOD OF INTRAVENOUS UROGRAPHY
YIELDING MAXIMUM INFORMATION IN THE SHORTEST POSSIBLE TIME.
1. SURVEY FILM C-R DIRECTED AT LEVEL OF UPPER MARGIN OF THE ILIAC CRESTS.
2. 5 MIN. EXPOSURE 5 MIN. AFTER INJECTION OF 20 cc OF DIODRAST.
3. IMMEDIATE APPLICATION OF PRESSUE OVER PROMONTORY OF SACRUM FOLLOWED BY 15 MIN. STEREOSCOPIC VIEWS TAKEN ON 10×12 FILMS WITH CENTRAL RAY SHIFTED SLIGHTLY CEPHALAD.
4. RELEASE FILM (IMMEDIATELY AFTER REMOVAL OF PRESSURE.)
5. ERECT FILM.
6. DELAYED FILMS MADE WHEN INDICATED.

Fig. 3. Chart of method of intravenous urography showing position of patient, cassette, tube and compression apparatus together with exposure intervals.

Case 1. This patient was operated on for bilateral undescended testicles in 1935. A mass developed in the left side of the scrotum while on overseas duty. A left orchidectomy was done in an overseas hospital. The histopathological report stated that the tumor was a teratoma. Convalescence was uneventful and the patient was referred for deep radiation therapy.

An intravenous examination of the urinary tract revealed poor visualization of the left upper collecting system. Retrograde filling under roentgenoscopic guidance was then done and showed an extreme degree of spasm of the calices. The proximal portion of the ureter was

irregular in contour and seemed to be somewhat displaced posteriorly. Serial exposures of the kidney area (Fig. 4) were made, proving that the irregularity in filling of the minor calices was due to spasm and not to organic destructive changes.

The patient was re-examined seven weeks later following deep roentgen therapy. Marked improvement had taken place as is shown in Figure 5*B*. The mechanism of the spasm of the calices is not known, there being no evidence of infection and no bleeding. It is quite possible that there were metastases in the region of the renal pedicle accounting for the deformity of the proximal portion of the ureter at *a* (Fig. 5*A*) and if so these metastases may have been responsible in some way for the caliceal spasm.

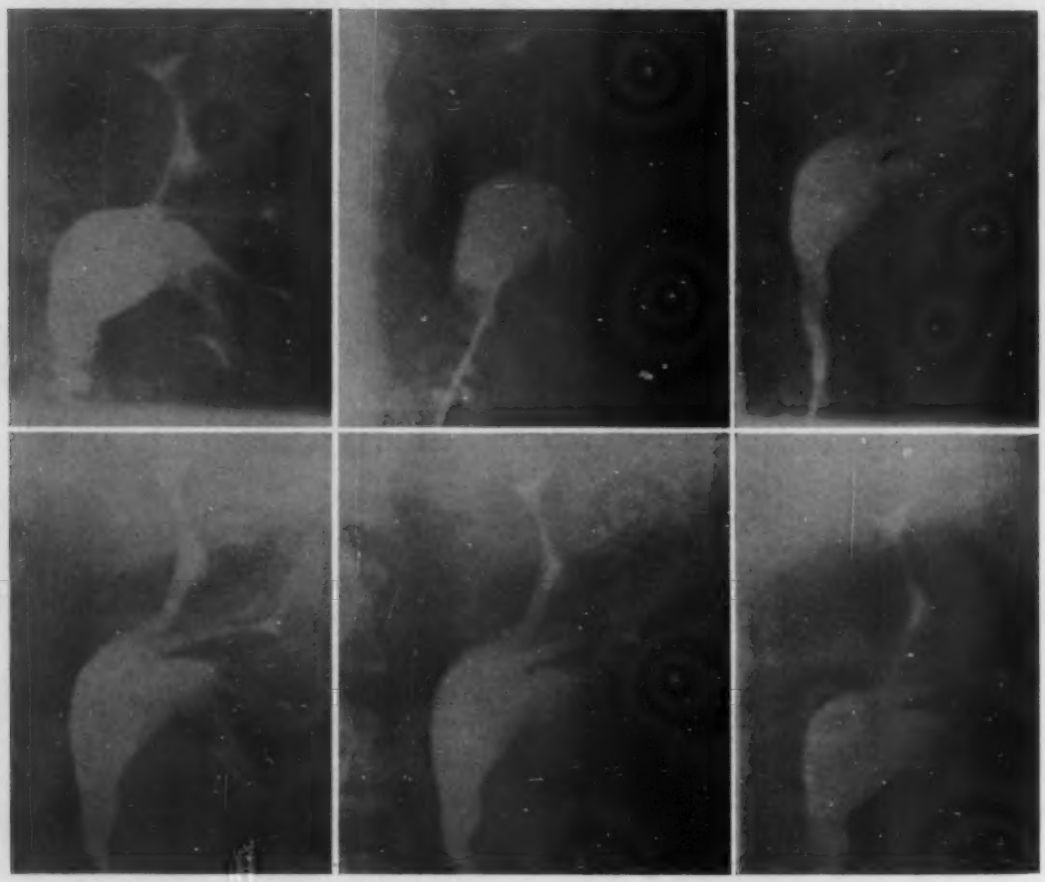

FIG. 4. Case 1. Testicular tumor. Spot roentgenograms of upper collecting system showing marked spasm of calices.

One of us (H. J. H.) has the following to say of this method of examination:

A survey of old and recent literature will reveal that fluoroscopic visualization of the upper urinary tract upon retrograde filling is generally condemned. The chief objections appear to be that the method is too time consuming and difficult, that most examiners have inadequate facilities and that serial urograms will give more accurate data in delineating detailed morphology and physiology. In our group the decision to carry out fluoroscopic visualization in selected cases has been a happy one. All of the above objections have been overcome. Excellent anatomical detail is obtained and constant filling defects are readily demonstrated. The method has been particularly valuable in the demonstration of retroperitoneal lesions and other pathological conditions which lie adjacent to the urinary tract and cause rotation, displacement and other deviations from normal. Re-examination due to in-

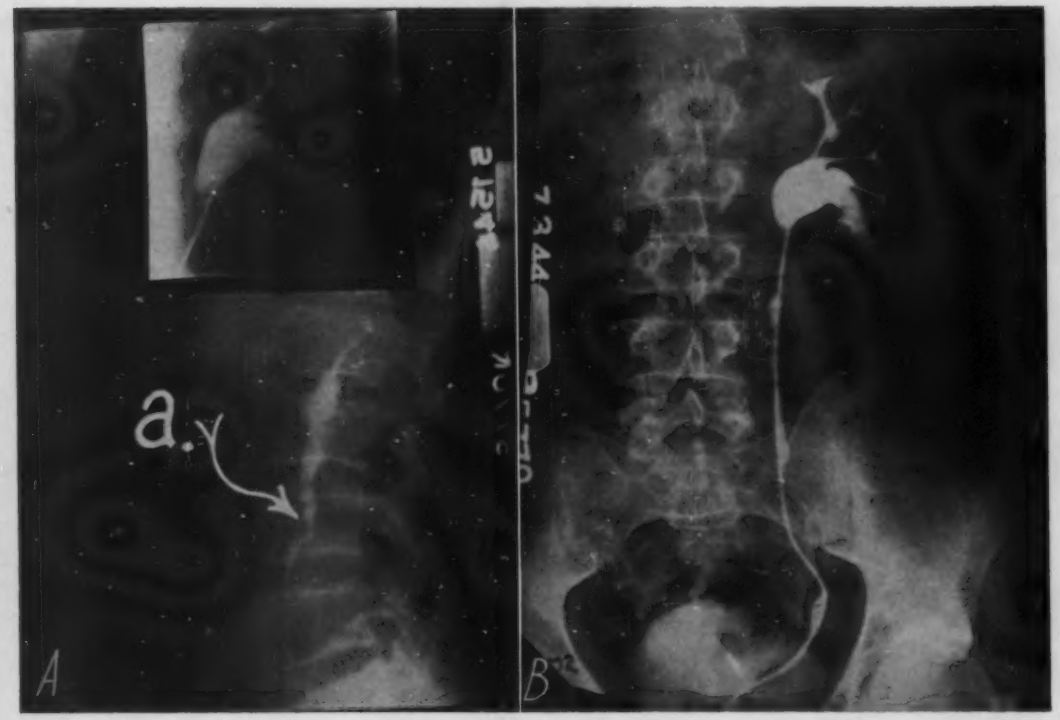

Fig. 5. Case I. Testicular tumor. *A*, spastic deformity of calices, and apparent slight displacement and angulation of ureter at *a*. *B* shows improvement following radiation therapy.

complete filling is almost entirely eliminated. Painful reactions which often follow overdistention are avoided.

The late Willis F. Manges advocated the use of the roentgenoscope in retrograde urography almost thirty years ago. Those interested in this method of examination should be familiar with his excellent paper entitled "Pyeloscopy."[4]

The Lateral Urogram. Mertz and Hamer,[5] Shiflett and Keith,[9] and others, have described this method of examination and have emphasized its value in the diagnosis of various conditions, particularly retroperitoneal lesions adjacent to some part of the urinary tract and perinephritic abscesses. We have seen one perirenal abscess in which this method of examination was of decided aid in diagnosis.

Fig. 6. Case II. Perinephritic abscess. Intravenous urogram showing marked cephalic displacement of upper collecting system on right indicated at *a*. Slight curvature of lumbar spine, concavity on right. Psoas shadow on right, obscured. Structures on left, normal.

CASE 11. This twenty-six year old prisoner of war was admitted to the Percy Jones General and Convalescent Hospital with a history of chills and fever three weeks prior to admission, lasting for six days. He was well for a week then developed pain in the right upper quadrant with elevation of temperature. Physical examination showed resistance to palpation in the right upper abdomen. The sedimentation rate was 80 mm. in the first hour. The urine was normal. The roentgenological examination showed a curvature of the lumbar spine, the concavity being on the right. The margin of the psoas shadow in the right renal area could not be seen. An intravenous urogram revealed the right kidney to lie unusually high, the lower pole appearing to be displaced anteriorly. These findings are shown in Figure 6. A roentgen diagnosis of perinephritic abscess was made. At operation approximately 8 ounces of creamy pus was found about the lower pole of the kidney. The infecting organism was the *Staphylococcus aureus*. The postoperative course was uneventful. Retrograde examination of the urinary tract was done after recovery. The kidney was still elevated, but the position of the lower pole was normal. The findings are shown in Figure 7.

In our work, the lateral urogram has been of greatest value in the diagnosis of metastases about the renal pedicles in individuals with testicular tumors and in the demonstration of mass lesions adjacent to some part of the urinary tract in Hodgkin's disease and other lymphomas as well as in the leukemias. Satisfactory roentgenograms in the lateral projection can seldom be secured during intravenous examination unless there is interference with emptying of the distal part of the ureter on the affected side. In most of our cases the retrograde method has been employed. The up-

FIG. 7. Case 11. Perinephritic abscess. *A* shows vertical rotation of right kidney with anterior displacement of pelvis, inferior calyx and proximal portion of ureter at *a*. This lateral view was made during an intravenous examination. The shadow is faint, but sufficiently well shown to be of value in diagnosis. *B*, lateral projection made by retrograde method following drainage of perinephritic abscess and after convalescence. Position of kidney and ureter at *b* is normal except that the kidney lies higher than is normally the case.

per collecting system is filled under roentgenoscopic guidance and stereoscopic roentgenograms made in the anteroposterior position using a tube shift transverse to the ureter. The patient is then turned into the lateral position with the affected side down, *great care being taken to secure a true lateral projection*. A relatively short exposure is desirable. We have found that 100 milliampere-seconds at approximately 88 kilovolts (peak) with a 36 inch focal distance is adequate in patients of average size. Normally in this projection the right kidney pelvis and calices usually lie lateral to the body of the second or third lumbar vertebra, the left being somewhat higher. The ureter passes downward and ventralward and emerges anterior to the spinal column at about the level of the fourth lumbar vertebral body (Fig. 8). There are some normal variations in the position of the kidney and ureter. These should be kept in mind. Mass lesions may displace or cause horizontal or

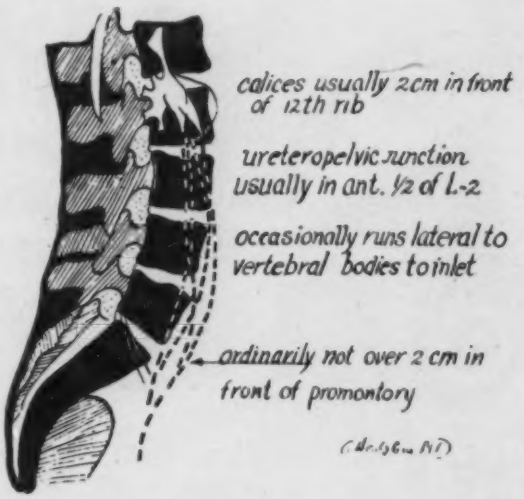
calices usually 2cm in front of 12th rib
ureteropelvic junction usually in ant. ½ of L-2
occasionally runs lateral to vertebral bodies to inlet
ordinarily not over 2 cm in front of promontory
Normal course ureters (lateral projection)

FIG. 8. Composite drawing by one of us (G.W.H.) showing position of right kidney pelves and ureters in relationship to the lumbar vertebral bodies in a series of patients where the findings were considered to be within normal limits.

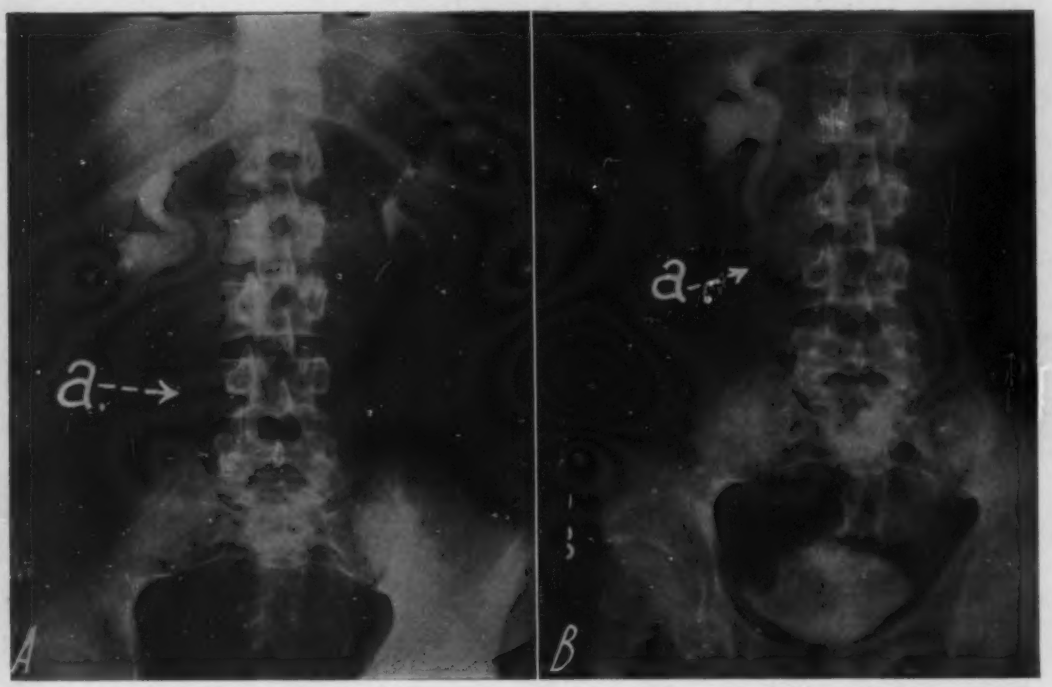

FIG. 9. Obstructing stone, right ureter. *A*, fifteen minute urogram shows stone in middle third of right ureter at *a*. Interference with drainage on right. Moderate dilatation of pelvis and calices. Normal excretion and drainage on left. *B*, sixty minute urogram shows complete emptying of pelvis and ureter on left. Obstruction of right ureter by stone at *a* with secondary dilatation proximal to stone well shown.

vertical rotation of the kidney and/or anteroposterior, posteroanterior or lateral displacement of the ureter.

OBSTRUCTIONS OF THE URINARY TRACT

The causes of high obstructions are well known. The common ones are stones (Fig. 9, 10 and 11), aberrant vessels or other congenital malformations (Fig. 12 and 17) and mass lesions adjacent to the ureteropelvic junction.

CASE III. This twenty-two year old white soldier was admitted to the Neurosurgical Service in May, 1944. He was struck in the back by a shell fragment in January, 1944, while engaged in action against the enemy. The wound resulted in a complete paraplegia below the eleventh dorsal dermatome. Fifteen hours later the wound was explored and two days later suprapubic cystotomy was performed because of overflowing incontinence of urine. He first developed symptoms of an infection of the urinary tract in March, but an intravenous urogram done at that time revealed no abnormality.

Upon admission here, there was some return of sensory and motor function in the lower extremities. The bladder had a capacity of approximately 60 cc. and infection was present. Tidal vesical irrigation was instituted as was supplemental chemotherapy. The suprapubic tube, and later the urethral catheter, was removed. The patient did well for a few days and then developed a high fever associated with severe pain in the left renal region. The roentgen examination of the urinary tract is illustrated in Figure 11. There were stones in the left kidney area, one of which lay at the junction of the pelvis with the ureter. The intravenous examination showed normal function on the right and marked impairment in excretion on the left. Only after a long period of delay was the upper collecting system faintly visualized on the left and it was obvious that the

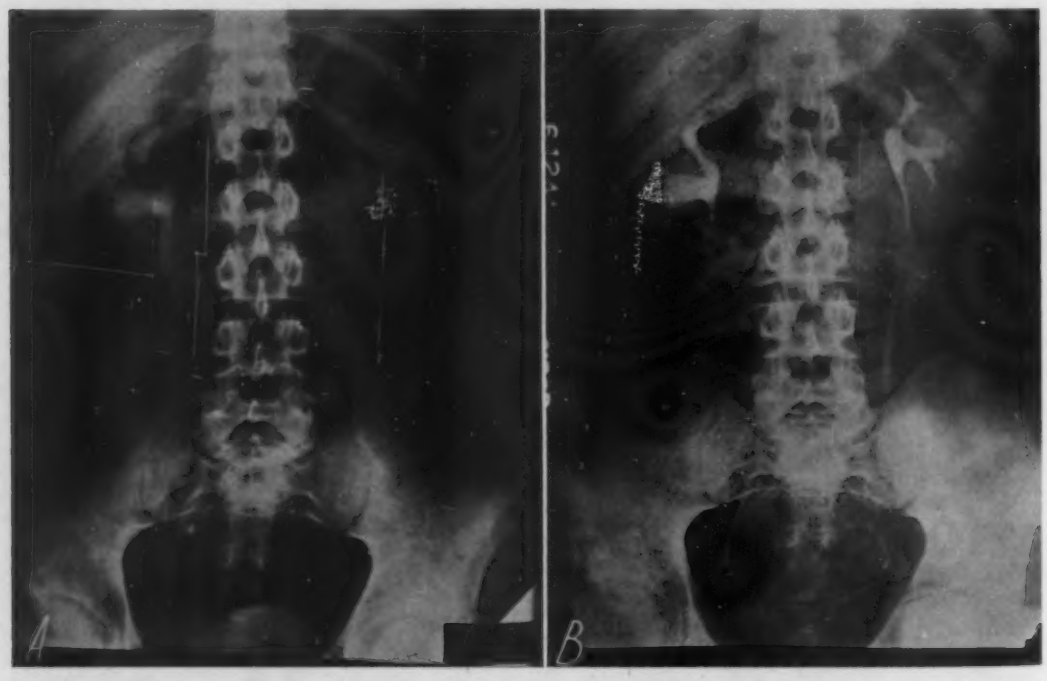

FIG. 10. Obstructing stone, right ureter. Catheters were passed by obstructing stone shown in Figure 9, and removed forty-eight hours later. Patient free from symptoms for a few days then again developed symptoms. An intravenous urogram was made at this time. *A* shows quite marked obstruction of the ureter at its junction with the bladder, the stone being shown in the latter area. Secondary dilatation proximal to the stone well shown. Stone extracted by transurethral manipulation. Recovery prompt. *B*, intravenous urogram made approximately three weeks after extraction of stone. Function and drainage normal on each side.

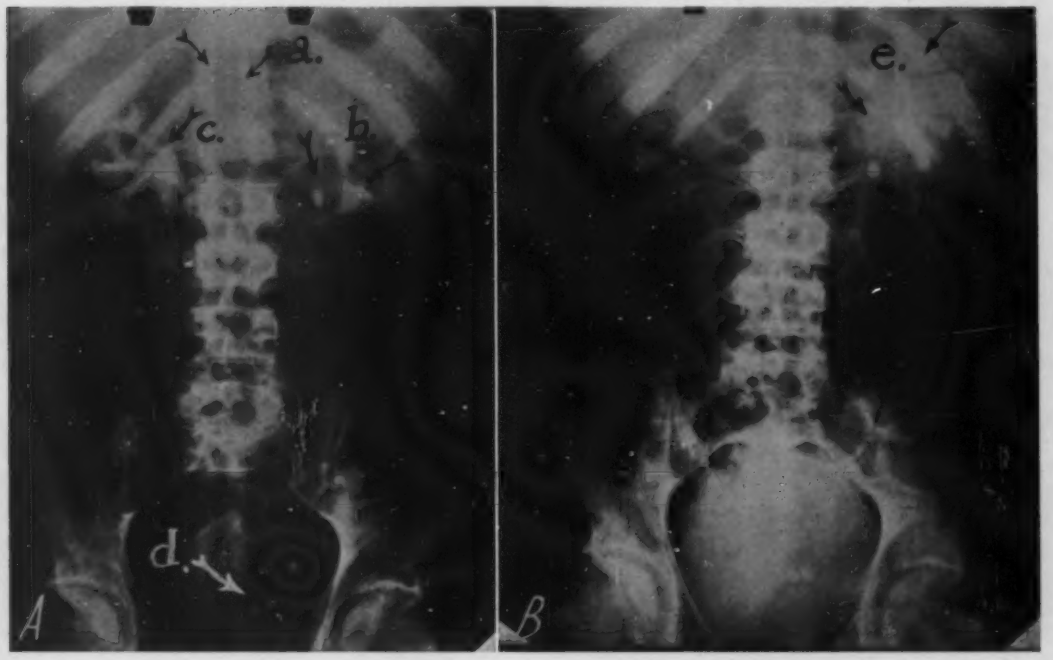

Fig. 11. Case III. Multiple stones, left kidney area and bladder. *A* shows defects in posterior arches of lower dorsal and upper lumbar region resulting from gunshot wound and operation, at *a*. Function on left markedly impaired. Stones in bladder indicated at *d* found imbedded in anterior wall of bladder at site of previous cystotomy. *B* shows rather faintly the upper collecting system on the left two and three-quarter hours after the administration of diodrast, at *e*. Stone at junction of pelvis with ureter indicated by lowest arrow is obviously causing marked obstruction and marked impairment of left renal function.

stone at the junction of the pelvis with the ureter was causing a high degree of obstruction.

There were two stones in the bladder area that were of interest. They were shown in stereoscopic roentgenograms to lie far anteriorly. At first they could not be found at cystoscopy, but later were shown to be imbedded in the anterior wall of the bladder at the site of the old suprapubic cystotomy.

The patient continued to show marked evidence of sepsis and the left renal area was explored, a purulent pyelonephritis being found and a nephrectomy done. The patient made a good recovery and is now ambulatory and voiding normally.

Case IV. This white soldier, aged forty-three, was admitted following evacuation from an overseas theater. He was hospitalized overseas chiefly because of a traumatic bursitis of the right elbow. A careful review of his history revealed only a mild mid-lumbar back pain with no radiation. Pain was dull in character and was increased with activity. The urine was normal at all examinations. An excretory urogram was done and a marked right hydronephrosis demonstrated. Figure 12*A* was made with the patient upright during intravenous urography. Fluid levels in markedly dilated calices on the right are well shown. A retrograde examination was considered advisable and the findings are illustrated in Figure 12*B*. The pelvis is markedly dilated as are the minor calices. The proximal part of the ureter is displaced, the changes being quite characteristic of those seen in the presence of aberrant vessel which is causing a high degree of obstruction. The patient was separated from the service without operative confirmation.

Obstructions of the lower urinary tract likewise are commonly caused by stones (Fig. 2 and 10), congenital malformations, strictures, primary bladder lesions such as tumors (Fig. 13) or diverticula (Fig. 14), and acute and chronic cystitis (Fig. 15 and 16). Delay in emptying of the ureters with dilatation may also be neurogenic or adnexal in origin.

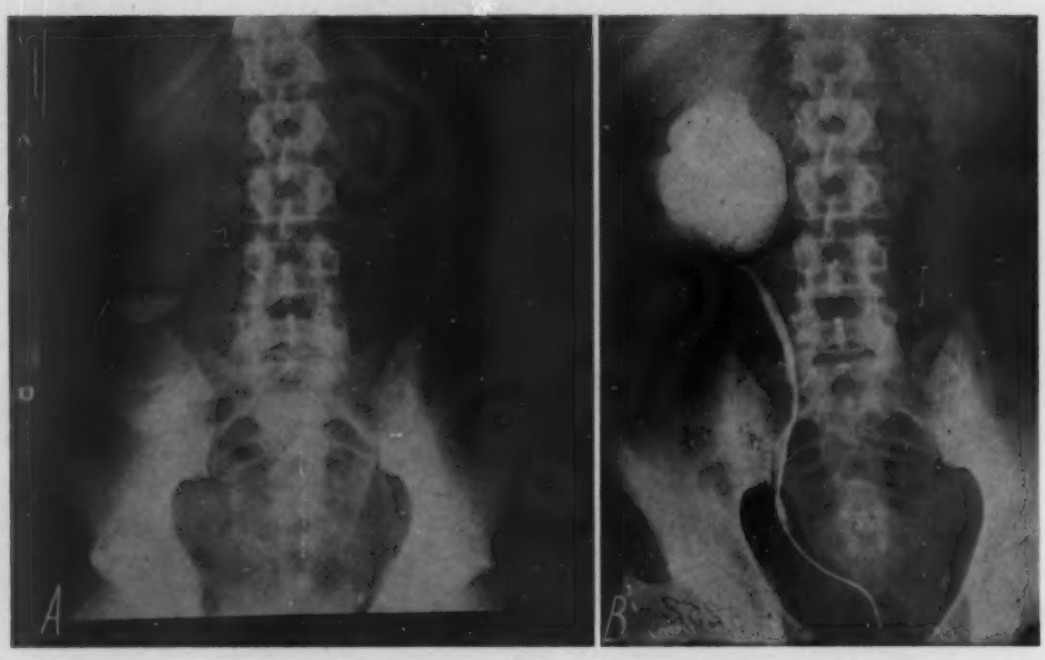

FIG. 12. Case IV. Obstruction at ureteropelvic junction, probably due to aberrant vessel. *A*, thirty minute intravenous urogram made with patient upright. Fluid levels in markedly dilated minor calices are well shown. *B* shows retrograde filling of upper collecting system done with roentgenoscopic guidance. Pelvis and calices are greatly dilated. Ureter displaced lateralward, probably due to presence of aberrant vessel.

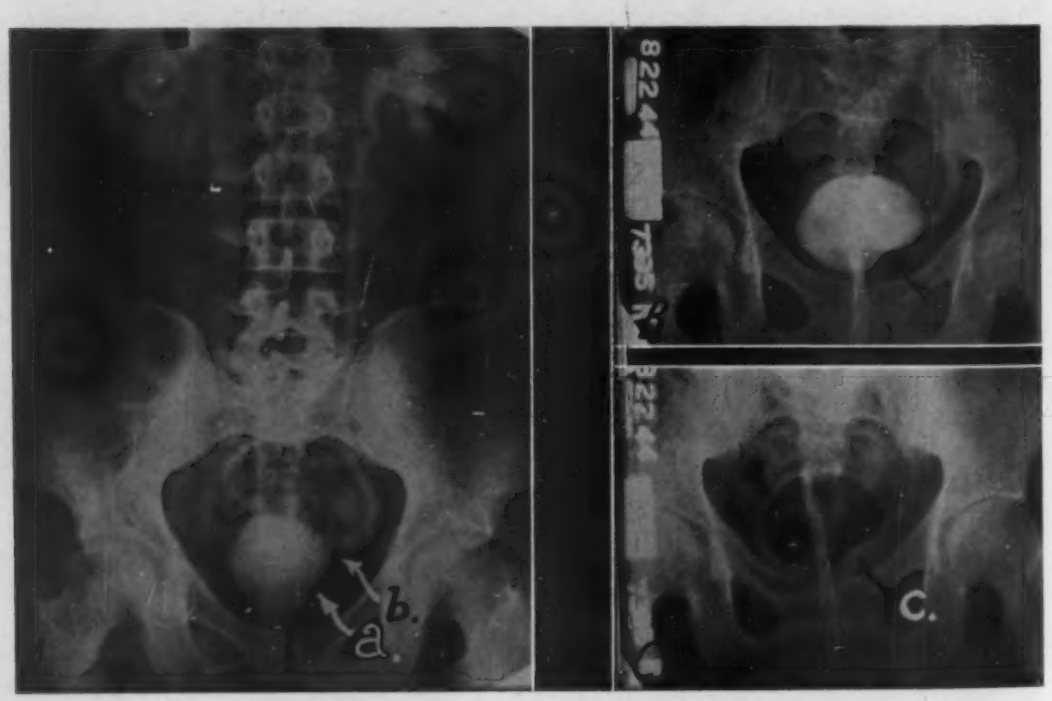

FIG. 13. Carcinoma of bladder. *A*, sixty minute intravenous urogram, very satisfactory. Deformity due to carcinoma shown at *a*. Partially obstructed left ureter shown at *b*. Markedly dilated right ureter and right kidney pelvis indicated by arrows in right upper quadrant. Impairment in function more marked on right

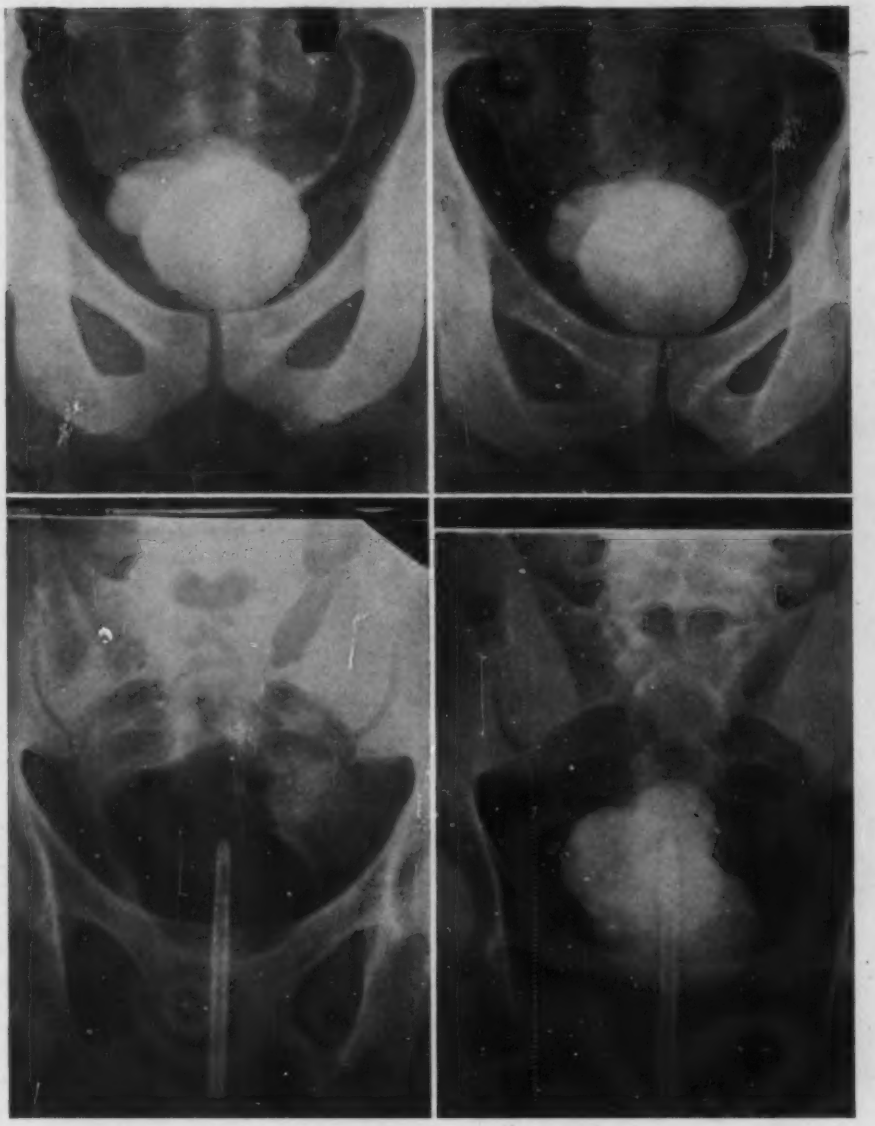

Fig. 14. A diverticulum of bladder with moderate interference to emptying of ureters. Patient was a white soldier, aged twenty-three. Transfer diagnosis: ulcer of bladder, probably malignant. History of urinary frequency and difficulty in urination early in adult life. Acute neisserian urethritis complicated by prostatic infection in 1940. Marked urinary frequency and urgency since then with pain in perineum when bladder was distended. Cystoscopy demonstrated severe hemorrhagic cystitis with no evidence of a malignant tumor, and partial obstruction of the bladder neck due to a congenital fold as well as hypertrophy of the musculature. The two intravenous urograms shown at the top reveal a large diverticulum of the bladder. This was confirmed at cystoscopy. Retrograde air and opaque cystograms shown at the bottom. Transurethral resection of bladder neck obstruction done. Patient is convalescing satisfactorily. Diverticulum to be excised later if necessary.

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than left. *B*, part of opaque retrograde cystogram. Defect in bladder due to tumor indicated by arrow. Reflux of contrast medium outlines left ureter. *C*, air cystogram made immediately after withdrawal of contrast material used in opaque cystogram. Tumor projecting into bladder at *c* is well demonstrated.

CASE V. This white soldier, aged eighteen, had been free from any urinary symptoms until July, 1944, shortly before induction into the Army. At this time he noted a profuse urethral discharge. He consulted a physician who told him that the discharge was non-venereal in origin and administered sulfanilamide medication. After a few days severe urinary urgency, frequency and dysuria appeared. He was given

FIG. 15. Case v. Acute cystitis and posterior urethritis. Sixty minute intravenous urogram. Markedly contracted and irregular bladder shown at *a*. Ureters are dilated. Dilated kidney pelves and minor calices indicated at points *b*.

local intraurethral therapy without benefit and gross hematuria developed. He was hospitalized almost immediately following induction because of his severe urinary symptoms.

Upon admission to the Percy Jones General and Convalescent Hospital examination demonstrated tenderness in the suprapubic area. There was evidence of prostatitis and seminal vesiculitis upon rectal palpation. Microscopic examination of the urine revealed innumerable red and white blood cells. Culture of the urine showed non-hemolytic *Staphylococcus aureus*.

Cystoscopic examination showed a very severe diffuse hemorrhagic cystitis and posterior urethritis. The capacity of the bladder was approximately 30 cc.

An excretory urogram was made. During the early part of the examination no evidence of opaque material could be seen. The tract was first satisfactorily visualized sixty minutes after the injection and the findings are illustrated in Figure 15. As will be seen, the bladder is markedly contracted and decidedly irregular in outline and the ureters are quite markedly dilated. The changes were considered to be the result of an unusually severe acute cystitis.

Therapy consisting of sulfadiazine, 1 gram every four hours, together with continuous irrigation of the bladder with a solution of lactic acid of increasing strength was instituted. The urinary symptoms subsided rapidly and the irrigation was discontinued after a period of one week. A residual infection of the seminal vesicles and prostate was treated. Three weeks following the beginning of treatment there was no evidence of infection in the genitourinary tract. An excretory urogram was made at this time. It showed normal excretion of the dye. The drainage of the ureters was free. The bladder was entirely normal in appearance. The findings are illustrated in Figure 16.

In such obstructions the intravenous examination is of primary importance and when continued over a sufficient period of time yields information of great value. Retrograde examinations are frequently also necessary in securing detailed information where the intravenous examination may indicate only the presence of some abnormality without resulting in satisfactory visualization of the part or parts under suspicion (Fig. 17). In a significant number of these cases roentgenoscopic guidance in filling is of definite value.

CASE VI. This white soldier, aged twenty-six, was admitted in March, 1944, with a diagnosis of left hydronephrosis. He had had scarlet fever without apparent complications in early childhood. Three years ago he suffered from gross hematuria accompanied by pain in the left upper abdomen for a few days. He was well until a few days before admission when he was

hospitalized because of chills and fever accompanied by gastrointestinal disturbances. Gross hematuria then reappeared together with pain in the left costovertebral region.

Physical examination revealed tenderness in the left upper quadrant and left costovertebral region. The kidney could be palpated. The blood pressure was normal. The urine contained innumerable white and red blood cells.

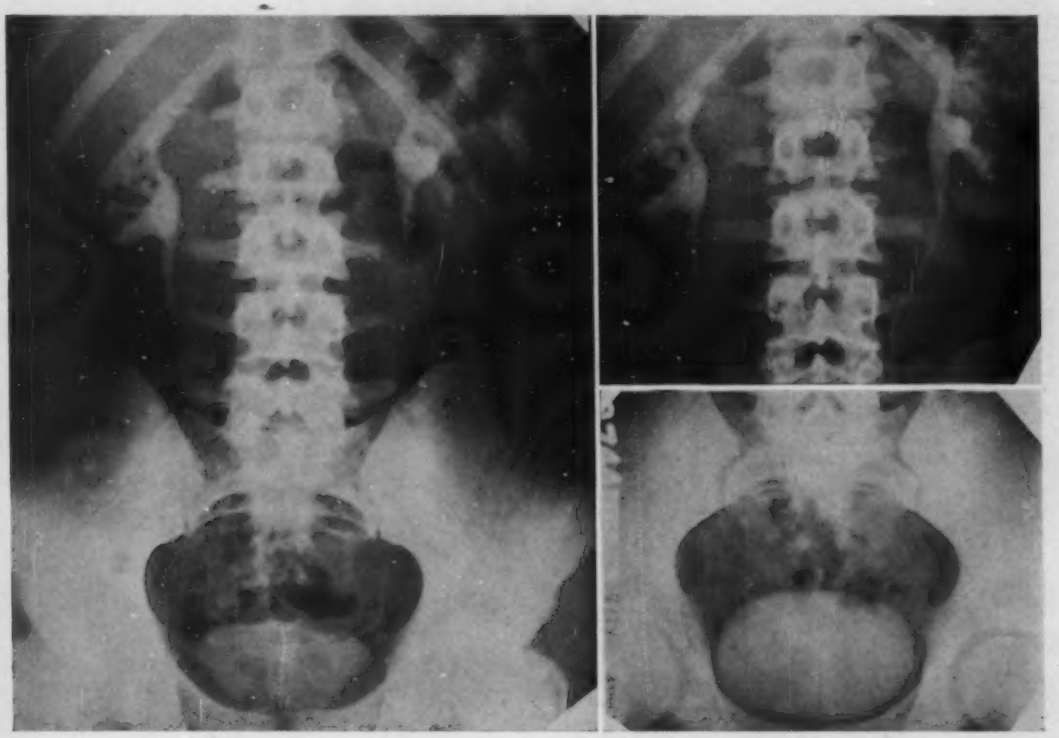

FIG. 16. Case v. Acute cystitis and posterior urethritis. Illustrations from intravenous examination done three weeks after beginning of treatment. Excretion and drainage are now normal. Dilatation has disappeared. Bladder shadow well shown and is entirely normal in appearance. Patient free from symptoms and evidence of disease at this time.

Culture showed non-hemolytic *Staphylococcus aureus*. The blood sedimentation rate was elevated and a definite leukocytosis was present.

An intravenous urogram was made. The structures on the right were quite well shown, but on the left they were not so well outlined and it was obvious that there was marked dilatation of the kidney pelvis and calices. The findings are shown in Figure 17*A*. The dilated pelvis is indicated at *a*. A retrograde urogram was considered to be indicated and filling was done under roentgenoscopic guidance. Our findings are shown in Figure 17*B*. The markedly dilated pelvis is indicated at *b*. The point of obstruction in the ureter at its junction with the kidney pelvis is indicated at *c*.

The value of retrograde filling is demonstrated in this case showing a marked degree of dilatation present which was only suggested by the intravenous examination.

The patient continued to suffer from pain, chills and fever that was as high as 104° F. at times. Catheterization of the left renal pelvis resulted in no improvement. An exploration of the renal area was done on April 4, 1944. About 400 cc. of purulent urine was aspirated from the left kidney. There was a relatively large aberrant vessel that crossed in front of the ureter at its junction with the kidney pelvis, apparently causing the obstruction. A marked perinephritis was present, as were numerous areas of cortical suppuration. A nephrectomy was done. Penicillin was administered and the postoperative course was uneventful. The patient is now clinically well. The urine is normal. The soldier was returned to duty May 24, 1944.

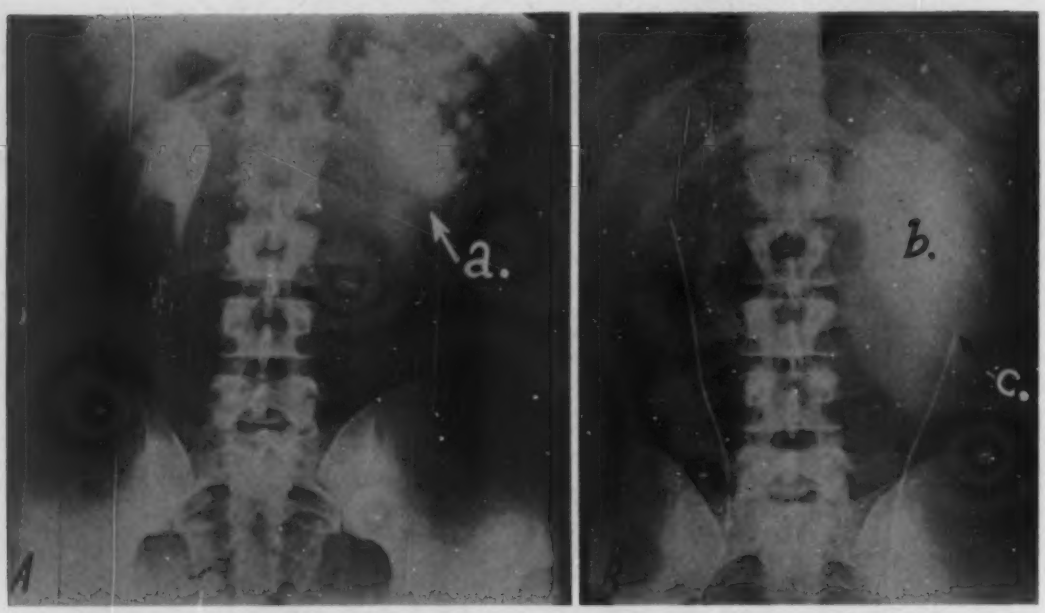

FIG. 17. Case VI. Marked pyelectasis with secondary pyelonephritis due to obstruction from aberrant vessel. *A*, forty-five minute intravenous urogram. Excretion on right, satisfactory. Pelvis moderately dilated. Some stasis is probably present. Excretion on left impaired. Minor calices deformed. Pelvis obviously markedly dilated, but only a suggestion of dilatation is demonstrated. Above findings shown at *a*. *B* shows retrograde filling of left kidney pelvis done under roentgenoscopic guidance. Tremendously dilated pelvis indicated at *b*. Point of obstruction due to aberrant vessel shown at *c*. Nephrectomy was done largely because of the marked destructive infectious changes in this kidney.

RENAL TRAUMA

Following renal injuries, the intravenous examination has proved to be of decided value. One may demonstrate the sequelae of trauma such as rupture of various parts of the urinary tract and at times show displacement of some portion of the collecting system resulting from hemorrhage or extravasation of urine. Retrograde examinations are necessary in some traumatic lesions and may yield detailed information not demonstrable by other methods. *Frequent follow-up examinations are always indicated.*

It is important to examine the surrounding structures carefully, particularly the chest and gastrointestinal tract in individuals who have suffered renal trauma (Fig. 18 and 19), especially following gunshot wounds.

CASE VII. This patient was admitted with a diagnosis of a supradiaphragmatic tumor in the right chest found in a routine roentgen examination in preparation for overseas duty. The patient had had an injury when struck by a bicycle in 1933. He was hospitalized complaining of pain in the lower right chest and abdomen. A microscopic hematuria was present for five days. Fractures of the right tenth, eleventh, and twelfth ribs were said to have been demonstrated at this time. The patient recovered promptly and was well until September, 1943, when he was again injured in the lower back and hematuria was noted which persisted for four or five days. A roentgen examination was not done at this time.

When admitted March 1, 1944, the lesion shown in Figure 18 was demonstrated. It did not move with the diaphragm. It was lobulated and was considered to be due to a benign lesion of some type, possibly a neurofibroma. The bony structures of the thorax and spine were examined carefully and were normal. A gastrointestinal examination failed to reveal any evidence of a diaphragmatic hernia or other abnormality.

On March 23, 1944, a thoracotomy was done at which time a cystic mass was found lying immediately above the posterior part of the right

side of the diaphragm. There was an opening through the adjacent portion of the diaphragm and the mass in the chest was found to extend through the opening in the diaphragm. It was removed. The upper pole of the kidney was palpated and seemed to be somewhat irregular.

The postoperative course was uneventful except for the removal of some slightly blood-tinged serum from the right side of the chest on two occasions. Microscopic hematuria was present for four or five days.

A microscopic examination of the tumor removed showed it to originate from atrophic kidney cortex. What appeared to be a portion of the kidney pelvis was found in the mass.

An intravenous urogram was then done. The findings are shown in Figure 19*A*. The left side of the tract was normal. On the right, however, an irregular mass of opaque material appeared high above the costal margin indicated at *a*. A retrograde examination seemed indicated. It was done under roentgenoscopic guidance. The lateral view is shown in Figure 19*B*. The appearance of the upper collecting system suggested that there had been a reduplication of the pelvis, only the lower division now being present. Supporting this was the fact that there was a small pouch-like shadow indicated at *b* which suggested filling of the proximal part of what might have been a divided ureter. The appearance of the pelvis and adjacent ureter is indicated at *c*.

There unquestionably was a rupture of the superior pole of the right kidney in this case, but whether or not the pelvis and proximal part of the ureter were divided as a result of a developmental variation from normal cannot be said with certainty although the findings certainly suggest this possibility. The injury apparently caused the traumatic rupture of the diaphragm as well as the injury to the kidney with secondary herniation of a portion of the kidney through the opening in the diaphragm.

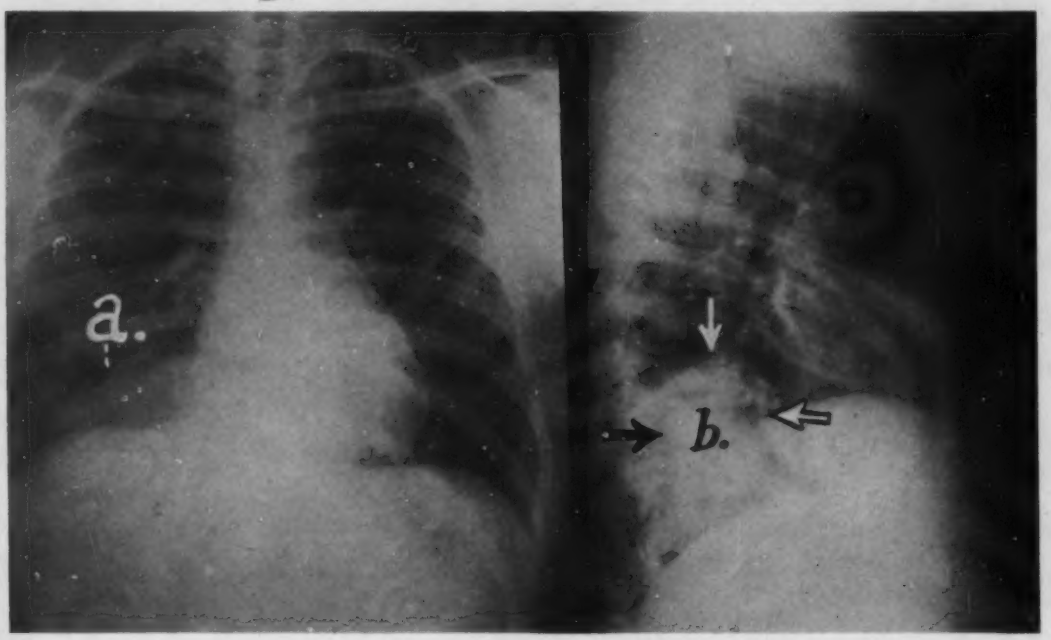

Fig. 18. Case vii. Diaphragmatic hernia, right. Traumatic rupture, right kidney. Fluid containing cyst in posterior part of right side of chest apparently connected with ruptured kidney. *a* and *b* indicate lobulated tumor in posterior right supradiaphragmatic area shown at operation to be cystic in nature and to extend through a rent in the posterior part of the right side of the diaphragm into the right kidney area.

The patient's convalescence was uneventful. He has no urinary symptoms at the present time and is now on temporary limited duty. It will remain to be seen whether or not there is a recurrence of renal bleeding.

Follow-up notes. The patient returned for reevaluation on December 5, 1944. Again a mass

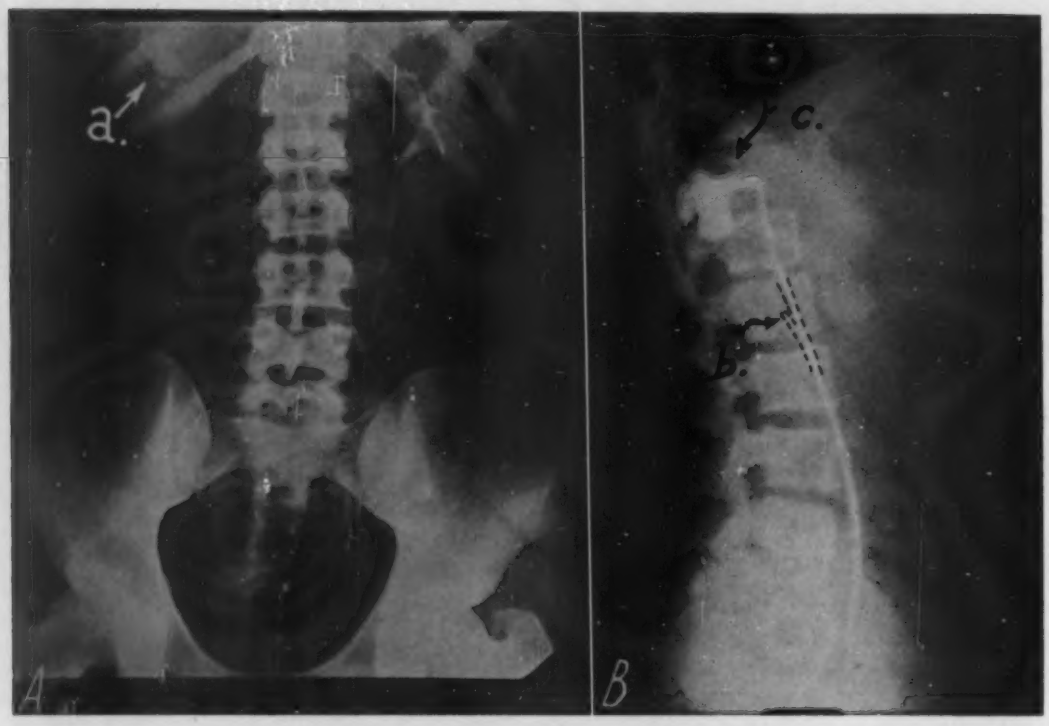

FIG. 19. Case VII. Traumatic rupture, right kidney. *A*, five minute intravenous urogram. Excretion and drainage on left, normal. Peculiar collection of opaque material on right shown at *a*. *B*, lateral view of retrograde urogram. *b*, small pocket-like area outlined by contrast medium thought possibly to represent the proximal part of one branch of a divided ureter. Structure at *c* suggests the lower division of a divided kidney pelvis and is obviously the same organ less well outlined by contrast medium at *a*.

FIG. 19*C*. Case VII. Resected right kidney showing hydronephrotic upper pole to which was attached an atrophic ureter. This apparently proves that there was a reduplication of the pelvis of this kidney and that there had been a traumatic rupture of the superior division.

was seen projecting above the right side of the diaphragm which was very similar to the one demonstrated at this hospital prior to operation in March, 1944.

The patient was transferred to Kennedy General Hospital and operated upon by Major Earl B. Kay. He reports that the operative approach used was transthoracic through the region of the previous operation. A cystic mass was found presenting through the diaphragm that was almost identical to the one found when the operation was performed here at Percy Jones General Hospital. It was densely adherent to both the upper and under surfaces of the diaphragm and was separated with some difficulty. The mass was found to be a part of a hydronephrotic upper pole of the right kidney to which a separate atrophic ureter was attached. The right kidney was removed and the defect in the diaphragm was repaired and closed. The patient had an uneventful postoperative convalescence.

The resected kidney is shown in Figure 19*C*. The kidney had been opened and the hydro-

nephrotic upper half is shown at the top of the illustration.

RENAL AND BLADDER LESIONS

A detailed consideration of primary renal and bladder abnormalities is not within the scope of this communication. Lesions primary in the kidney are frequently well demonstrated either by the retrograde or intravenous method, a combination of the two often yielding information not attainable from one or the other alone. The technique used is identical with that above described.

Abnormalities of the bladder are sometimes well demonstrated in the cystogram obtained during intravenous urography. More often, however, special methods of examination are indicated, retrograde opaque and air cystograms being employed. These are illustrated in Figure 13.

Excellent visualization of a primary renal neoplasm is shown in Figure 20. The differential diagnosis lay between a neoplasm and solitary cyst. A correlation of the clinical and roentgenographic findings made possible the correct diagnosis.

Case VIII. This officer, white, aged fifty, was admitted for diagnosis in March, 1944, complaining of some pain in the right groin and anterior thigh. The preliminary roentgenogram made before doing a barium enema showed what seemed to be a markedly enlarged right kidney shadow, the lower pole extending below the costal margin. An intravenous urogram was made. The structures on the left were normal. The excretion on the right was excellent, but the middle and inferior calices were elongated and seemed to surround the upper margin of a large mass that extended downward below the level of the iliac crest. A retrograde examination was considered advisable and was done under roentgenoscopic guidance. The findings are shown in Figure 20. A large tumor is shown at *a*, the lower margin of which is outlined by a dotted line. The middle and inferior minor calices seemed to surround the upper pole of the soft tissue mass which was causing medial rotation of the kidney and medial displacement of the proximal portion of the ureter. Figure

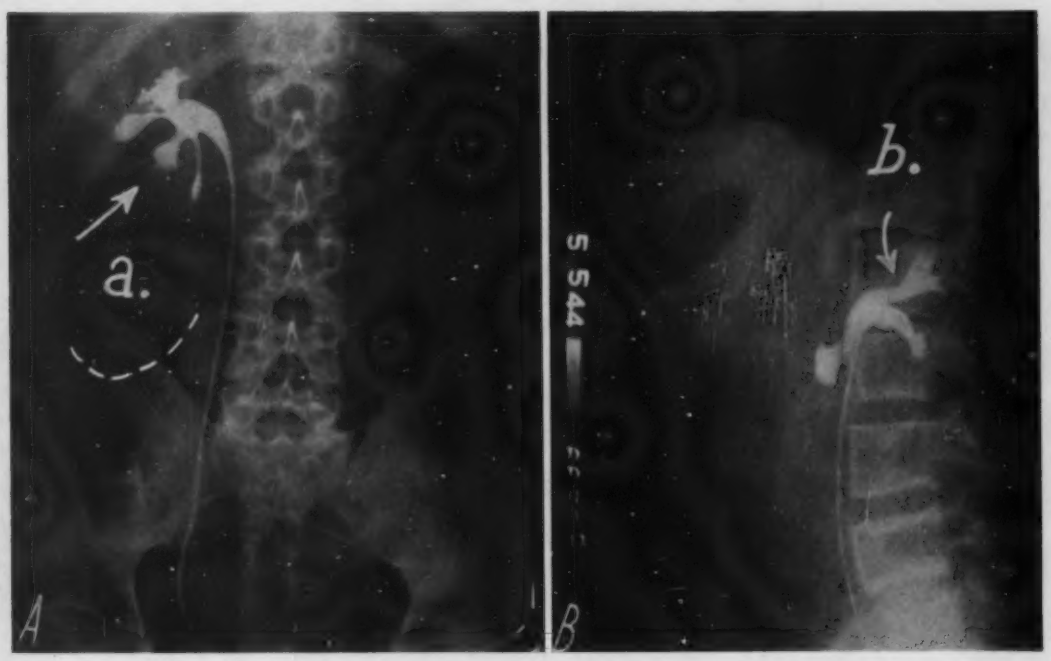

Fig. 20. Case VIII. Adenocarcinoma of lower pole of right kidney. *A* shows a very large tumor at the lower pole of the right kidney, at *a*. Adjacent calices deformed. Kidney rotated. Proximal ureter and pelvis displaced medially. *B*, lateral view; *b* indicates displacement of middle and inferior calices. Both horizontal and vertical rotation of the kidney is demonstrated.

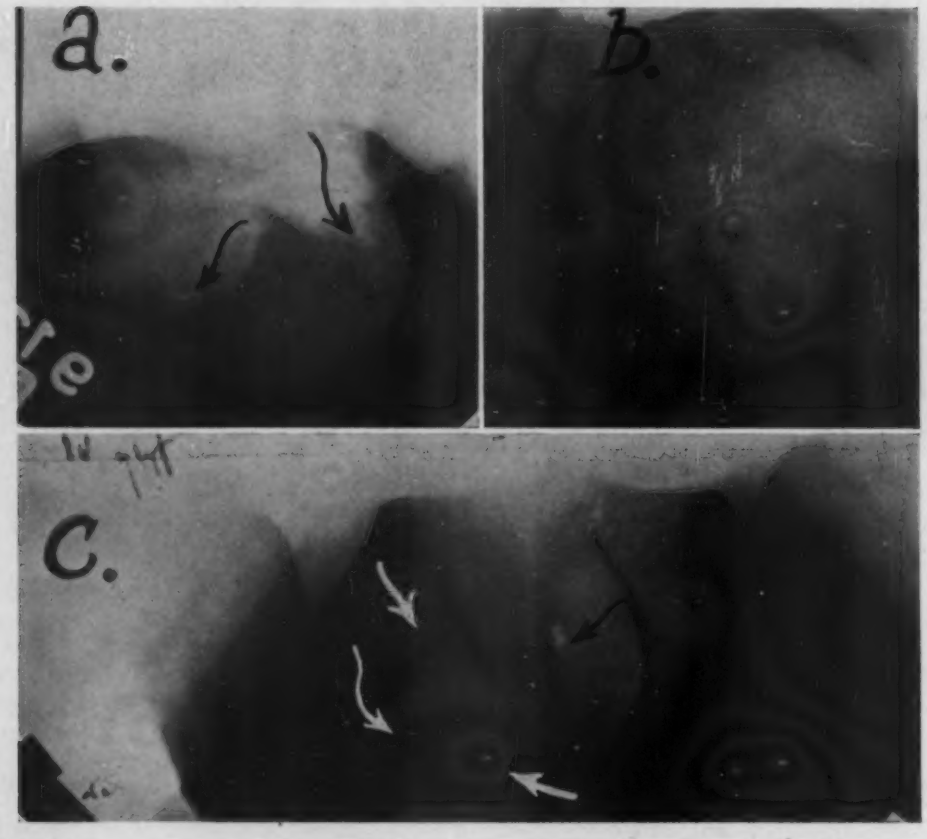

FIG. 21. Roentgenograms of the scrotum and its contents in three different cases. *a*, shows dense shadow indicated by arrow on the left, in a patient with a small tumor of the right testicle. The tumor gradually became smaller and finally could not be palpated, but the calcification persisted. Operation revealed an apparently normal testicle with a small calcium deposit free in the capsule surrounding the testicle It was thought that the calcification had previously been within or attached to the testicle and had been extruded or detached. Arrow on the right indicates enlargement in left side of the scrotum due to varicocele. *b*, shows a large malignant tumor of the right testicle. No calcification is present. *c*, indicates extensive irregular calcification in the right side of the scrotum partially outlining a tumor. This calcification is outside the testicle and is considered to be due to an extensive tuberculous infection of the epididymis. This has not been proved since operation in this case was not considered advisable.

20*B* is a roentgenogram made in the lateral projection. The kidney is rotated, the pelvis being displaced anteriorly and somewhat cephalad. There is some anterior displacement of the proximal part of the ureter. The differential diagnosis rested between a very large solitary cyst or a primary malignant tumor involving the lower pole of the kidney. There was no history of bleeding, but because of the patient's age it was considered that the changes were at least three to one in favor of a malignant tumor. At operation June 1, 1944, a very large inoperable tumor was found involving the entire lower pole of the kidney. Microscopic section showed a necrotic adenocarcinoma. The patient was referred for deep roentgen therapy.

TESTICULAR TUMORS

The roentgen examination of the scrotum and its contents is of interest and in some cases of diagnostic importance in the examination of patients with obscure lesions of the scrotal contents (Fig. 21). Calcification may be evidence of an adult type of teratoma as opposed to an embryonal type of tumor such as seminoma. Calcification, however, may be the result of a tuberculous infection of the epididymis as was the case in one of our patients. This lesion could easily have been mistakenly diagnosed a malignant teratoma.

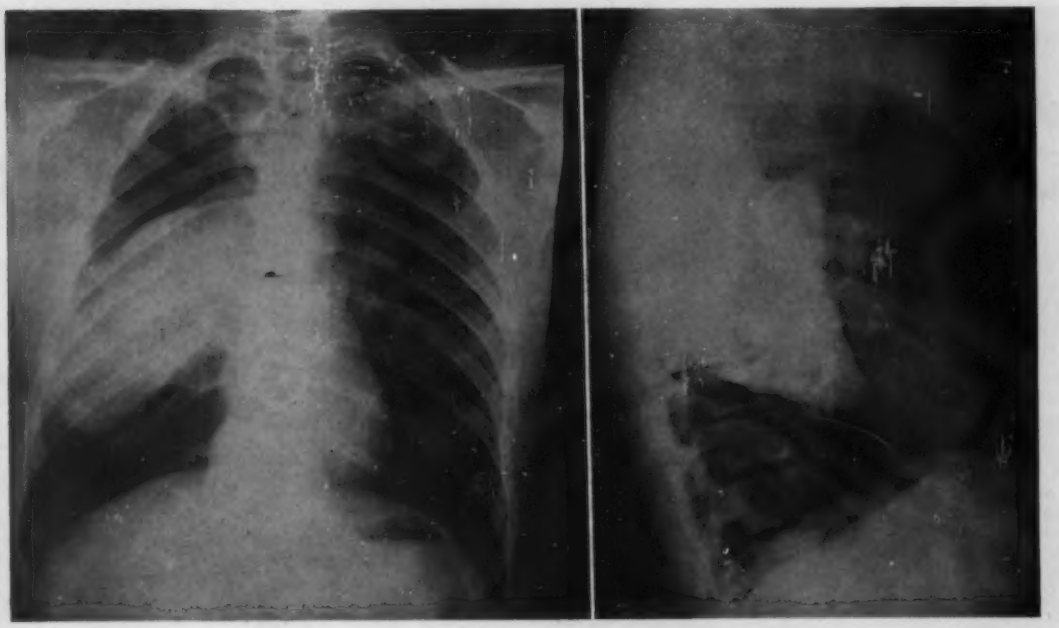

Fig. 22. Case IX. Malignant testicular tumor with metastases. Roentgenograms show metastatic lesions in posterior part of right hemithorax. Major involvement apparently in apex of lower lobe.

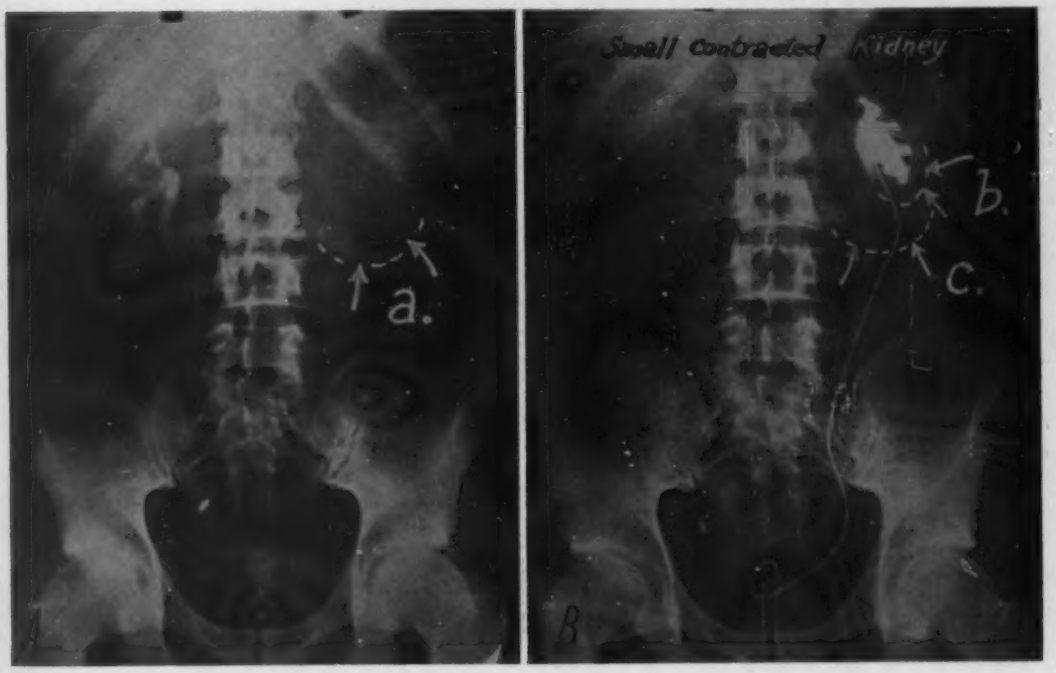

Fig. 23. Case IX. Malignant testicular tumor with metastases. *A* shows large tumor outlined at *a*. This illustration is part of an intravenous examination. The function and drainage on the right were normal. There was no evidence of any excretion on the left. *B* shows the lower pole outline of a small contracted kidney at *b* and the lower margin of a metastatic tumor at *c*. The ureter is displaced laterally and there is both horizontal and vertical rotation of this kidney.

Fig. 24. Case IX. Malignant testicular tumor with metastases. Marked posterior displacement of proximal portion of ureter by metastatic tumor shown in lateral projection at *a*.

Skeletal and abdominal visceral metastases are rare in testicular tumors. Metastases to the chest, either lymphogenous or hematogenous in origin are relatively common and are best demonstrated in conventional chest roentgenograms, a lateral projection always being a part of this examination (Fig. 22). The most common site of metastasis is in the region of the renal pedicle

Case IX. This twenty-seven year old white corporal developed swelling in the left testicle in the fall of 1939. A left orchidectomy was done in April, 1940, and heavy deep radiation therapy was given postoperatively. Recovery was uneventful.

The patient was well until July, 1943, when he began to suffer from low back pain and respiratory distress. Two months later hemoptysis developed. He entered Percy Jones General and Convalescent Hospital in April, 1944. The roentgen examination showed a very large dense lesion occupying the region of the apex of the right lower lobe and an intravenous urogram revealed a non-functioning left kidney. Retrograde filling of the left side of the urinary tract showed posterior displacement of the proximal end of the left ureter and the adjacent portion of the left kidney pelvis. The kidney was somewhat atrophic in appearance. A large spherical mass was shown lying immediately anterior to the displaced ureter and kidney pelvis. The patient was given radiation therapy. His general condition remains satisfactory although there has been relatively little change in the extensive metastatic lesions thus far.

The metastatic chest lesion is shown in Figure 22. The urinary tract findings by intravenous examination are shown in Figure

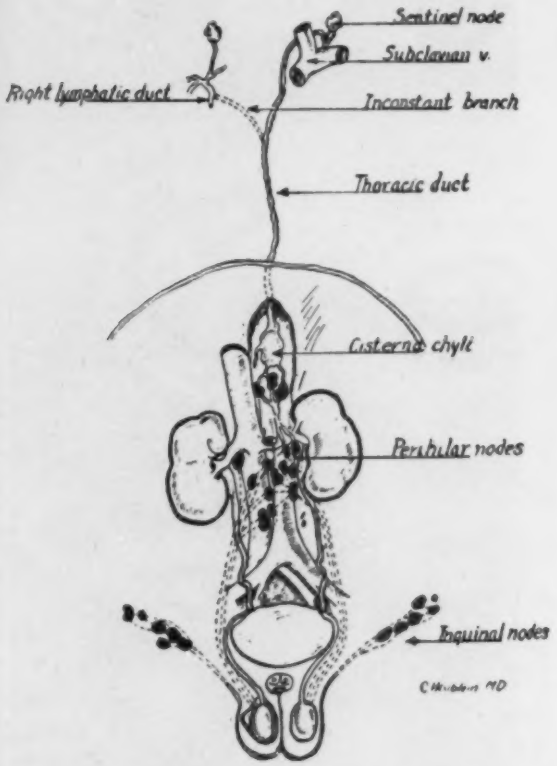

Fig. 25. Drawing by one of us (G.W.H.) showing lymphatic pathways extending proximally from the testicles to the peri-aortic lymph nodes, demonstrating the tendency to cross from right to left at the level of the renal pedicles and extending cephalad by way of the thoracic duct to the sentinel lymph node in the left supraclavicular space. The lymphatic pathways draining the skin of the scrotum are shown leading to the inguinal nodes. These are usually involved only late in testicular neoplasm.

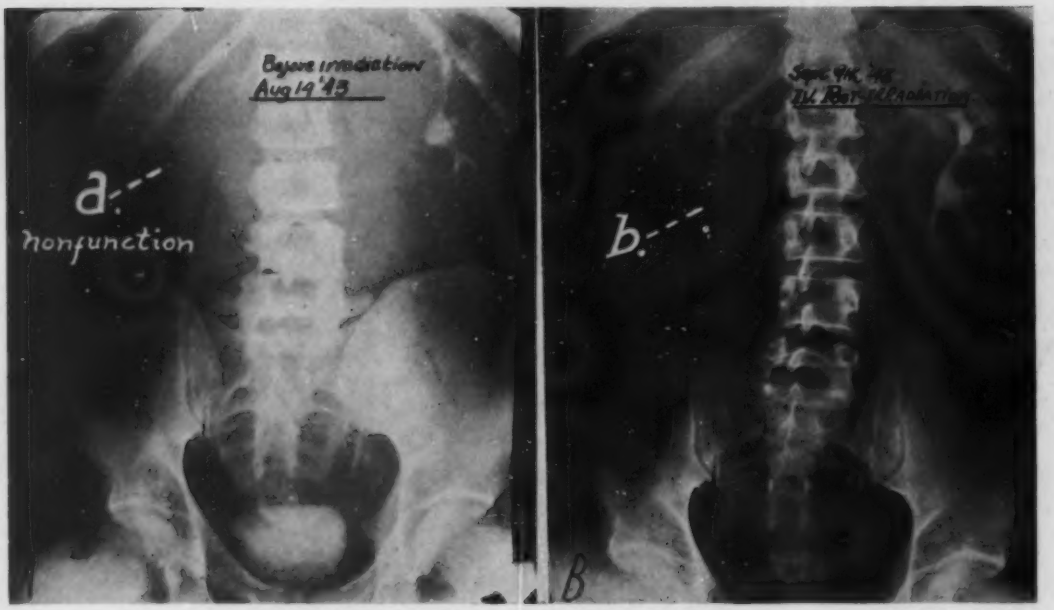

Fig. 26. Testicular neoplasm with metastases. *A* shows non-functioning right kidney at *a*. Function on left is satisfactory, but kidney is markedly displaced laterally. *B* shows return of function in right kidney. Displacement of left kidney is still marked, but somewhat less so than before. Case is to be reported in detail elsewhere.

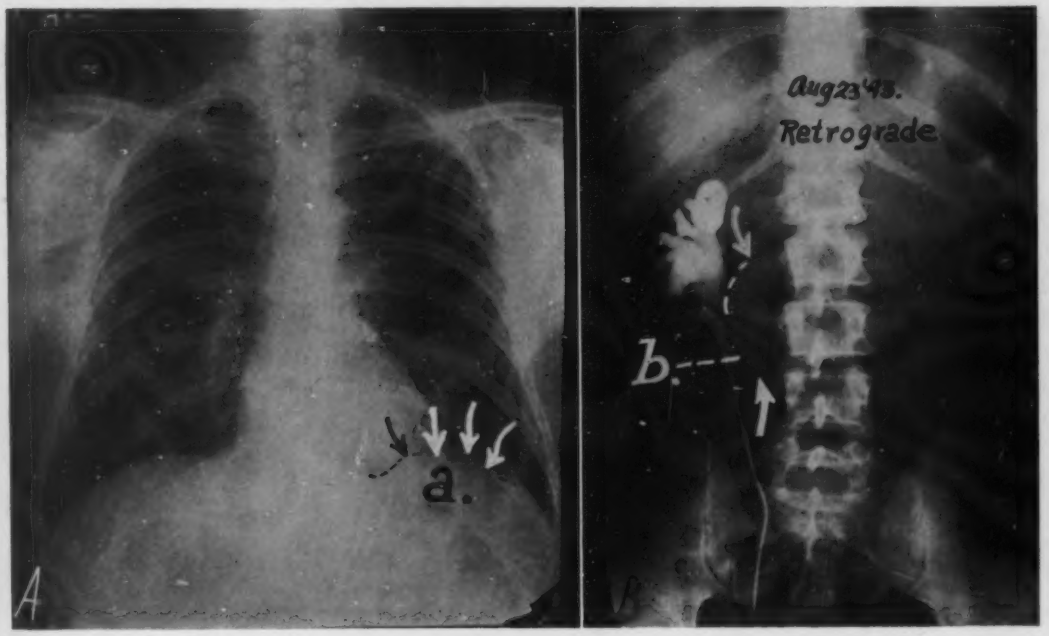

Fig. 27. Testicular neoplasm in same patient shown in Figure 26. *A* shows metastatic lesion at *a*. This disappeared promptly following radiation therapy. *B* shows retrograde filling of upper collecting system on the right at the time when no function could be demonstrated during the intravenous examination. The kidney and proximal part of the ureter are displaced laterally. A large metastatic tumor is outlined at *b*.

23*A*. The excretion in the right side of the tract is shown to be normal and the structures are well outlined. There is no evidence of any contrast material on the left and at *a* is shown a very large tumor which lies near the left renal pedicle. In Figure 23*B* retrograde filling of the involved upper collecting system is shown. Roentgenoscopic guidance was utilized. The shadow of the lower pole of the kidney is outlined at *b* and the lower margin of the tumor is outlined at *c*. The kidney appears somewhat contracted. The proximal portion of the ureter

neoplasm, "with the crossing from right to left of these lymphatic channels and with the tendency to massive growths at the level of the renal pedicle" (Randall) (Fig. 25). In other words, although a right or left testicular tumor may show predominantly unilateral metastases in the corresponding side of the abdomen, nevertheless right-sided tumors not infrequently involve the region of the left renal pedicle as is demonstrated in Figures 26 and 27.

FIG. 28. Case x. Testicular tumor with metastases. *A*, intravenous urogram showing normal function and drainage. What suggested lateral displacement of the left ureter by a metastatic mass is shown at *a*. *B*, lateral retrograde urogram made shortly after *A*. The kidney pelvis and ureter appear to be essentially normal in position.

is seen to be displaced laterally quite markedly. In Figure 24 the proximal part of the ureter is deviated posteriorly at *a*. The proximal part of the kidney pelvis is also displaced.

In a previous paragraph we have called attention to the work of Randall who has stated that "intravenous urography is a valuable asset in determining the prognosis in cases of metastases from testicular tumor." Both Randall,[8] and Chamberlin and Jamison,[2] demonstrate conclusively the importance of finding unilateral anuria in patients with this disease. One should recall the route of lymphatic spread of testicular

Our experience with testicular lesions during the last two years indicates that the above facts have not always been fully recognized. We believe very definitely that *intravenous urography at proper intervals coupled with frequent chest examinations affords the best possible method of following the progress of these patients* (Fig. 28, 29 and 30). The information obtained from good intravenous urography, with retrograde examination when necessary, often will determine when roentgen therapy should be terminated, or conversely, be energetically pursued to the limit of skin

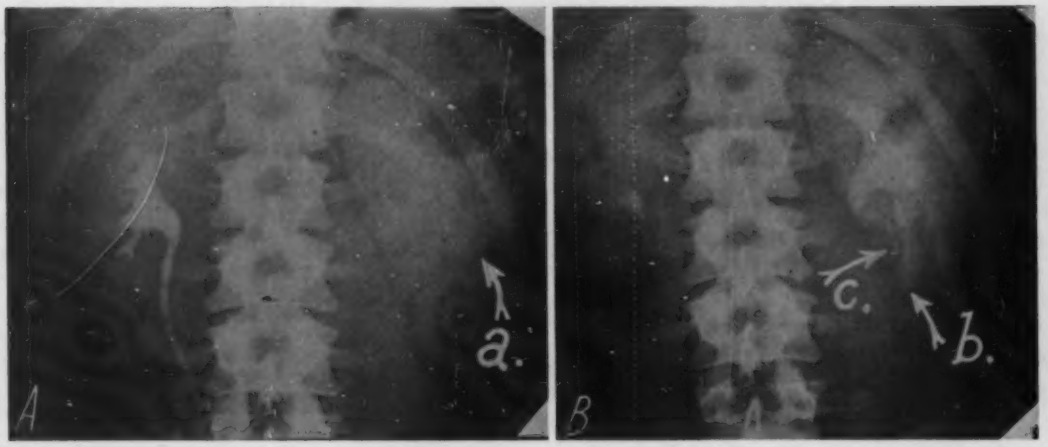

Fig. 29. Case x. Testicular tumor with metastases. *A*, fifteen minute intravenous urogram. Excretion and draining on right are normal. Dense left kidney shadow shown at *a* with only a suggestion of beginning filling of dilated minor calices. *B*, sixty minute urogram. Upper collecting system on left is now quite well shown. The ureter is markedly displaced, indicated at *c*, and apparently partially obstructed at *b*. This examination was made approximately two months following the one shown in Figure 28. In that figure early metastases are only suggested while the diagnosis is obvious at the later examination.

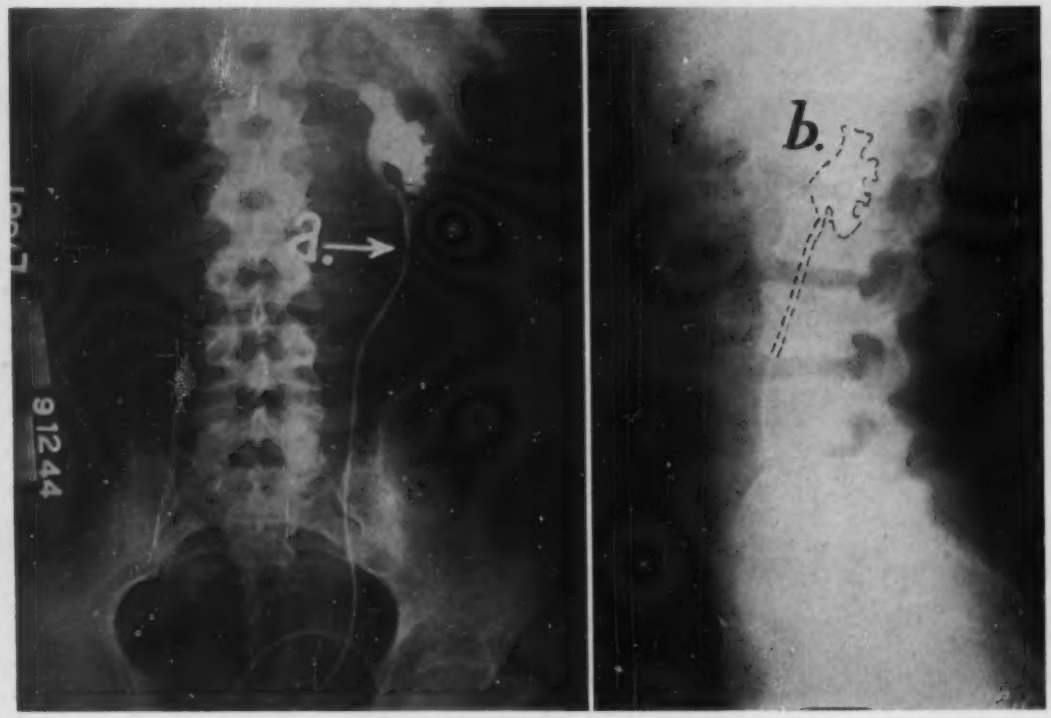

Fig. 30. Case x. Testicular tumor with metastases. Retrograde examination made one month after the intravenous examination shown in Figure 29. Displacement of ureter well shown at *a*. The lateral urogram indicated at *b* shows only very slight posterior displacement of the proximal part of the ureter.

tolerance. A falling urinary prolan affords the roentgenologist little comfort in the face of symptoms of persistent backache and positive urinary tract signs such as obstructive uropathy or homolateral anuria. By the same token, a temporary elevation of urinary prolan may be of no importance[2] when found in those whose general condi-

tion is excellent, whose subsequent course indicates apparent freedom from metastatic disease and in whom the urogram shows practically normal findings. Nash and Leddy[6] state: "Hormonal analyses are at best unreliable as far as the diagnosis of seminoma of the testis is concerned."

CASE X. This white soldier, aged twenty-one, was admitted to Percy Jones General and Convalescent Hospital in June, 1944. He gave a history of noting a mass in the left testicular area in September, 1943. This mass increased in size and in April, 1944, an orchidectomy was done at an overseas installation. The tumor was said to be a teratoma.

Upon admission a tumor was again found in the left scrotum. Chest examination showed nodular masses in the lung fields characteristic of metastases. An intravenous examination of the urinary tract on June 10, 1944, showed normal excretion. There was questionable slight lateral displacement of the proximal part of the left ureter indicated at *a* in Figure 28*A*. A lateral urogram made at this time (Fig. 28*B*) revealed nothing definitely abnormal. It was thought that there might well be early metastases displacing the proximal part of the left ureter. The patient was given radiation therapy to the chest, the mass in the left side of the scrotum and to the lymphatic pathways draining the scrotal area. The metastatic lesions in the chest regressed promptly and disappeared. The scrotal mass became much smaller. On August 18 the tumor in the left side of the scrotum was removed. A recurrent embryonal carcinoma was found. Extensive necrosis was present, evidently resulting from irradiation, but there were a few viable tumor cells.

A second intravenous examination of the urinary tract was done September 9, 1944. At this time excretion was found to be markedly delayed on the left, the function being quite markedly impaired. The findings are shown in Figure 29. In Figure 29*A* the right pelvis and ureter are well outlined, but there is only a suggestion of opaque material in the minor calices of the left kidney. This renal shadow is very dense and is indicated at *a*. Figure 29*B* shows a urogram made sixty minutes after administration of the diodrast. Marked displacement of the ureter is shown at *c* and an apparent partial obstruction of the ureter indicated at *b*. Retrograde examination (Fig. 30) confirms the above findings, but fails to show any gross abnormality in the lateral projection (Fig. 30*b*).

Our urographic data* suggest that lateral displacement of the renal shadow and proximal ureter is a frequent, if not pathognomonic, finding in neoplasm of the testis (Fig. 31). Occasionally a secondarily contracted kidney is observed. Huge mass lesions may be present with negligible subjective complaints on the part of the patient (Fig. 32). Lateral urograms usually reveal slight posterior renal or ureteral displacement although in one recent instance marked anterior displacement of the kidney shadow and ureter was demonstrated, thus producing an appearance easily mistaken for a postperitoneal sarcoma or indurated perinephritic abscess.

CASE XI. This twenty-nine year old corporal first noted a soft tumor in the left testicular area in December, 1943. He was examined and clear fluid aspirated. The testicle continued to increase in size and on March 25, 1944, an orchidectomy was done in an overseas hospital and a teratoma, the type of which was not reported, was found. Patient admitted to our hospital for radiation therapy May 8, 1944.

Physical examination showed a large firm tumor in the left upper quadrant of the abdomen. Intravenous urography demonstrated normal function on the right and markedly impaired function on the left. A retrograde urogram was done under roentgenoscopic guidance and the findings are shown in Figure 31. There is marked deformity of the proximal part of the left ureter and dilatation of the minor calices at *a*. The pelvis and calices are displaced posteriorly at *b*.

Re-examination following deep radiation therapy showed improvement in the function on the left and less distortion of the ureter. The patient's condition was excellent when discharged to a Veteran's Facility for further care, but the ultimate prognosis is grave.

CASE XII. This white soldier, aged twenty-six, first noted a mass in the left testicle in June, 1943. Slow painless enlargement took place. In June, 1944, he experienced severe pain

* Based on the observation of 65 cases of testicular tumor at Percy Jones General and Convalescent Hospital during the past two years.

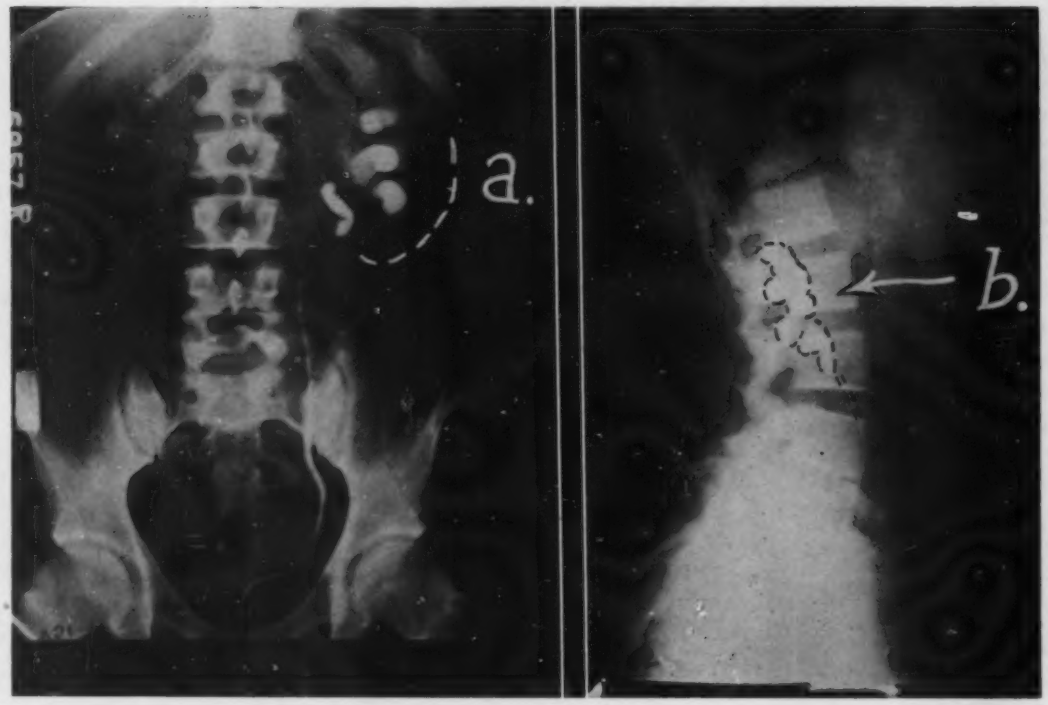

Fig. 31. Case xi. Testicular tumor with metastases. Retrograde examination showing marked distortion of proximal portion of ureter and dilatation of minor calices. Kidney pelvis and proximal ureter displaced laterally and posteriorly. Margin of kidney shadow is indicated at *a* and posterior displacement at *b*.

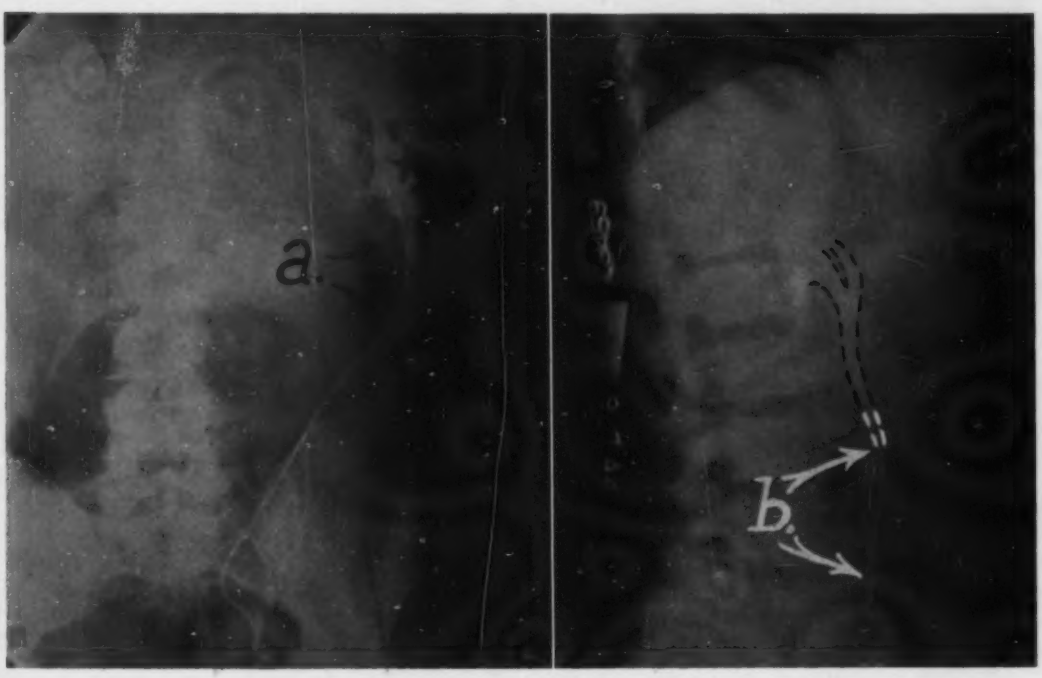

Fig. 32. Case xii. Testicular tumor with metastases. Urograms show marked lateral and anterior displacement of left kidney pelvis and ureter indicated at points *a* and *b* due to huge metastatic deposits.

in the left side of the scrotum and was immediately hospitalized. Physical examination revealed a large hard tumor in his left upper abdomen which extended downward below the level of the umbilicus. The mass extended medially beyond the midline and was hard, non-tender and nodular.

The findings at intravenous urography revealed impairment in the renal function on the left. The kidney was markedly rotated laterally and displaced laterward as well. A very large tumor mass was faintly shown lying medial to the displaced upper collecting system.

A retrograde urogram was also made and the findings are shown in Figure 32. The marked displacement of the kidney and ureter and the evidence of rotation is well shown at *a*. Anterior displacement of the ureter, most marked in the lower lumbar region, is shown at *b*.

The patient is being given deep radiation therapy. It remains to be seen what the final outcome of this case will be.

CASE XIII. This white soldier, aged twenty-three, was admitted with a diagnosis of postoperative teratoma of the left testis. He was well until January, 1944, when, while serving overseas, he fell astride a log. He noted severe pain in the left side of the scrotum at this time and shortly afterward palpated a small hard nodule in the testis. He had no further symptoms until June, 1944, when the pain returned and a very definite nodule was found in the left testicle. An orchidectomy was done and a teratoma of the testicle was reported.

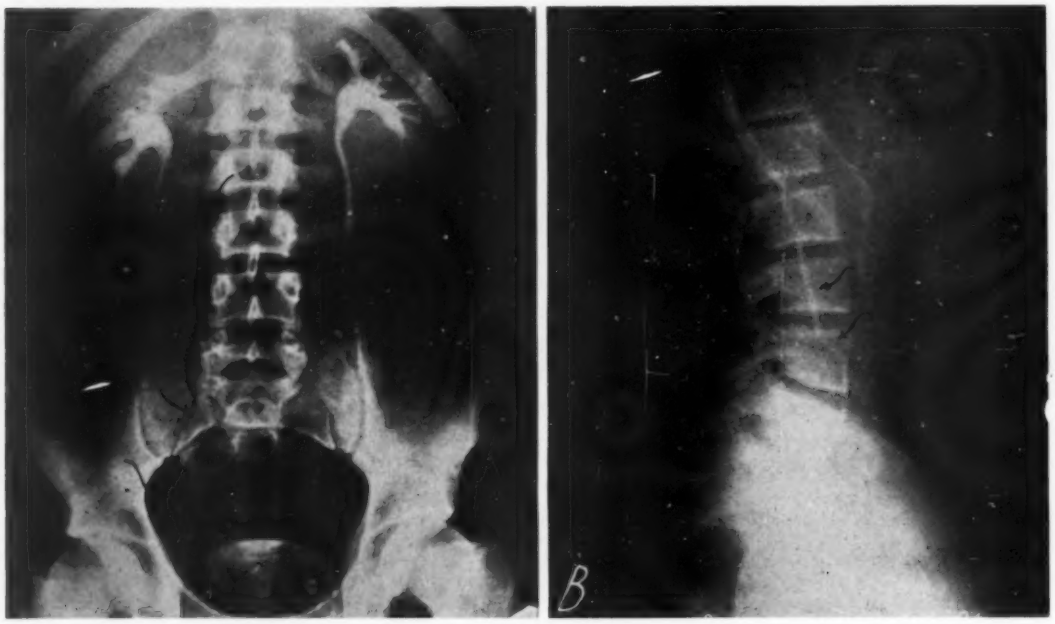

FIG. 33. Case XIII. Teratoma of left testis with questionable metastases. Fifteen minute urograms made during an intravenous examination. Partial obstruction of the distal portion of the right ureter is shown near the level of the ischial spine. The ureter is displaced medially and posteriorly above this level. There is a suggestion of what may be lateral displacement of the ureter at the level of the third lumbar vertebra. *B*, unusually satisfactory lateral projection. Visualization of this type is possible only when there is interference to emptying of the distal part of the ureter.

The patient was returned to the United States for further observation and care and was admitted to this hospital for deep radiation therapy. Upon admission he seemed to be clinically well. An excretory urogram was made and our findings at the fifteen minute period are shown in Figure 33. The function was normal. There was evidence of a partial obstruction of the right ureter near the level of the ischial spine and a suggestion of what might be a tumor could be seen medial to the area of narrowing in the ureter. There was also a suggestion of lateral displacement of the ureter near the level of the third lumbar vertebra. The ureter lay quite far posteriorly. Whether these changes

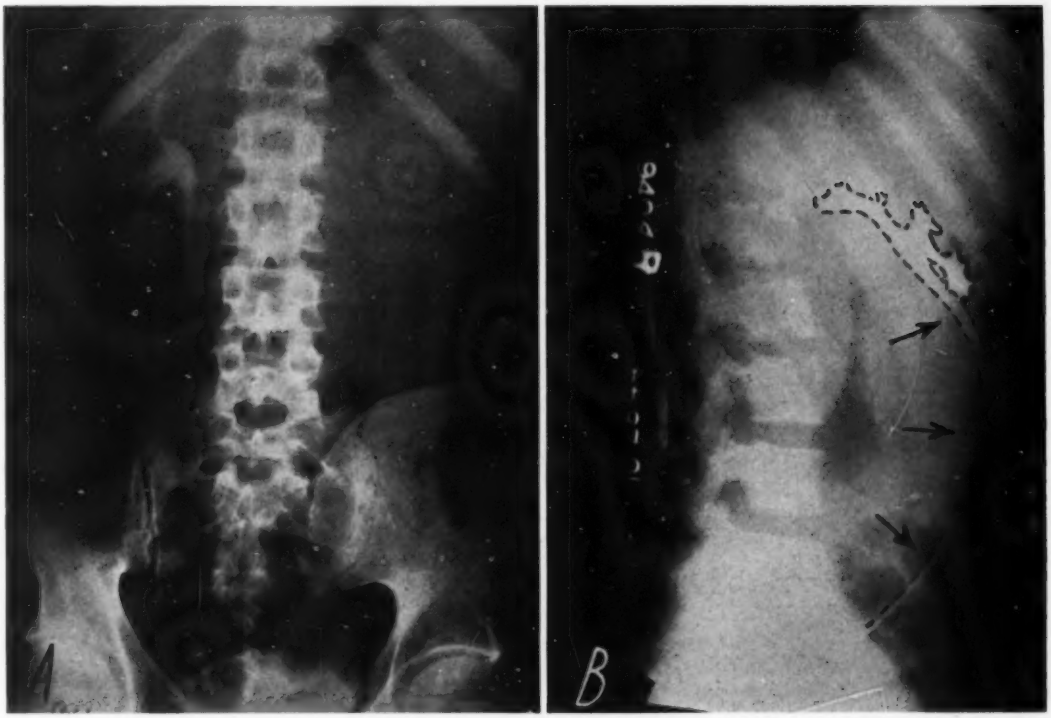

Fig. 34. Case xiv. *A*, intravenous urogram shows a large tumor mass filling the left side of the abdomen. The kidney was still functioning, but was displaced upward and rotated outward. The structures on the right were normal. *B*, left lateral retrograde urogram, showing marked anterior displacement of the distal two-thirds of the kidney and of the greater part of the ureter by a huge metastatic mass.

were due to masses displacing the ureter or a normal variation could not be said with certainty, but it seemed probable that metastases were present.

A careful physical examination failed to reveal any palpable masses in the abdomen. The patient was having no urinary symptoms at this time. Radiation therapy was instituted. A follow-up examination has not been done as yet and our findings can be taken only as suggestive of metastases. It is not usual for a left testicular tumor to metastasize to the right although this may occasionally occur.

The above findings are in sharp contrast to our experience with abdominal Hodgkin's disease, where the pathological changes have often been displacement or obstruction of the ureter in its distal two-thirds (Fig. 38, 39 and 40).

In our experience the intravenous urogram has been of marked value in the demonstration of metastases in the area of the urinary tract and is the method of choice in the primary study of these cases. It is a reliable index of function and of decided aid in prognosis. Early changes are manifested by displacement and/or rotation of the kidney or proximal portion of the ureter on the affected side. Displacement of the proximal part of the ureter is perhaps even a more frequent finding than renal displacement. Marked impairment or complete absence of renal function on the affected side is not infrequently encountered in advanced cases and is usually of serious import. The retrograde examination assumes major importance in a more detailed study and particularly in borderline cases. Here the lateral projection often yields information not demonstrable by other methods.

The retrograde filling of the upper collecting system of a kidney which at the intravenous examination has shown no evidence of function is of interest, often show-

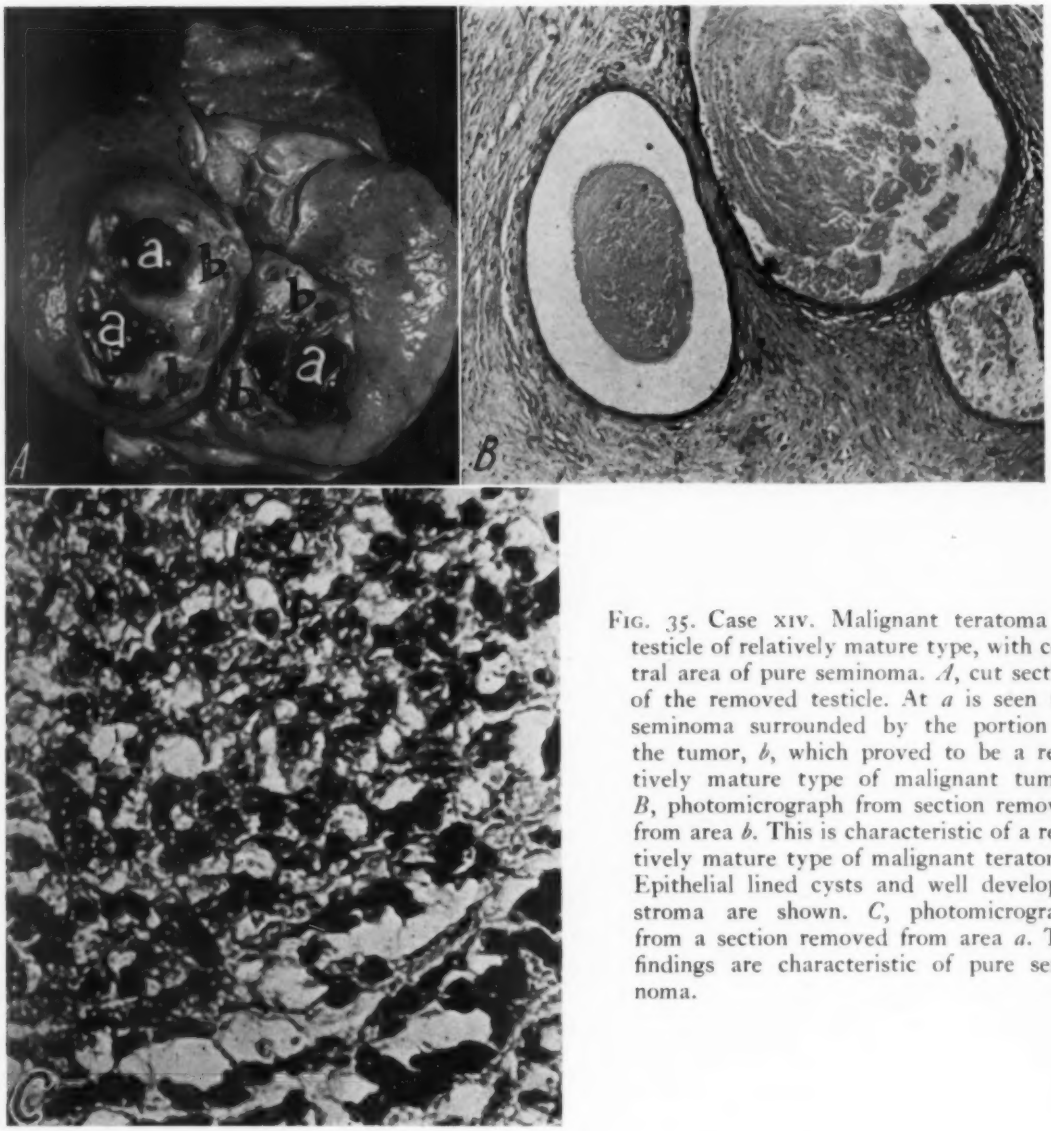

FIG. 35. Case XIV. Malignant teratoma of testicle of relatively mature type, with central area of pure seminoma. *A*, cut section of the removed testicle. At *a* is seen the seminoma surrounded by the portion of the tumor, *b*, which proved to be a relatively mature type of malignant tumor. *B*, photomicrograph from section removed from area *b*. This is characteristic of a relatively mature type of malignant teratoma. Epithelial lined cysts and well developed stroma are shown. *C*, photomicrograph from a section removed from area *a*. The findings are characteristic of pure seminoma.

ing the system to be essentially normal in appearance. This is in keeping with the prompt return of function that so frequently follows adequate radiation therapy (Fig. 26 and 27). The mechanism of the disturbed function in these cases is not entirely understood at the present time.

Attention is again directed to the fact that the intravenous examination is of great aid in prognosis and in estimating the results of radiation therapy. For example, the return of function in a previously non-functioning kidney following irradiation may indicate a good therapeutic result. On the other hand, when a previously functioning kidney ceases to function during or following radiation therapy the prognosis is grave (Fig. 28, 29 and 30).

As is generally recognized large metastatic lesions in the region of the renal pedicles cause marked displacement and at times compression of the adjacent parts of the gastrointestinal tract. Gastrointestinal examinations and frequent re-examinations, including those of the small bowel, are done when indicated. The importance of this is

illustrated by Case xiv. Not only were the stomach and proximal small bowel markedly displaced, but a high degree of obstruction was found near the junction of the duodenum with the jejunum. The history and findings in this case follow.

Case xiv. The patient developed pain in left inguinal area in June, 1944. This became increasingly severe and radiated down the lateral aspect of the thigh. The first hospital admission was in September, 1944, at which time a large firm tumor mass was found in the left upper quadrant. The patient was transferred to Percy Jones General and Convalescent Hospital. An examination of the urinary tract (Fig. 34) showed the kidney to be displaced to the left, anteriorly and cephalad as was the proximal two-thirds of the ureter. It was obvious that the tumor mass was retroperitoneal in location, the major portion being in the region of the left renal pedicle. Because of the location, primary tumor of the testicle was considered a distinct possibility and physical examination disclosed a small palpable left testicular mass. An orchidectomy was done. The findings, as stated in the pathological report, were a teratoma of the testis exhibiting a focus of embryonal carcinoma. They were of interest because of the demonstration of seminoma cells lying within a mature teratoma of mixed type. This tumor contained not only urinary bladder and pelvic epithelium, but also embryonal neuroblasts or cells having the appearance of retinoblasts (Fig. 35). The prolan was less than 300 mouse units.

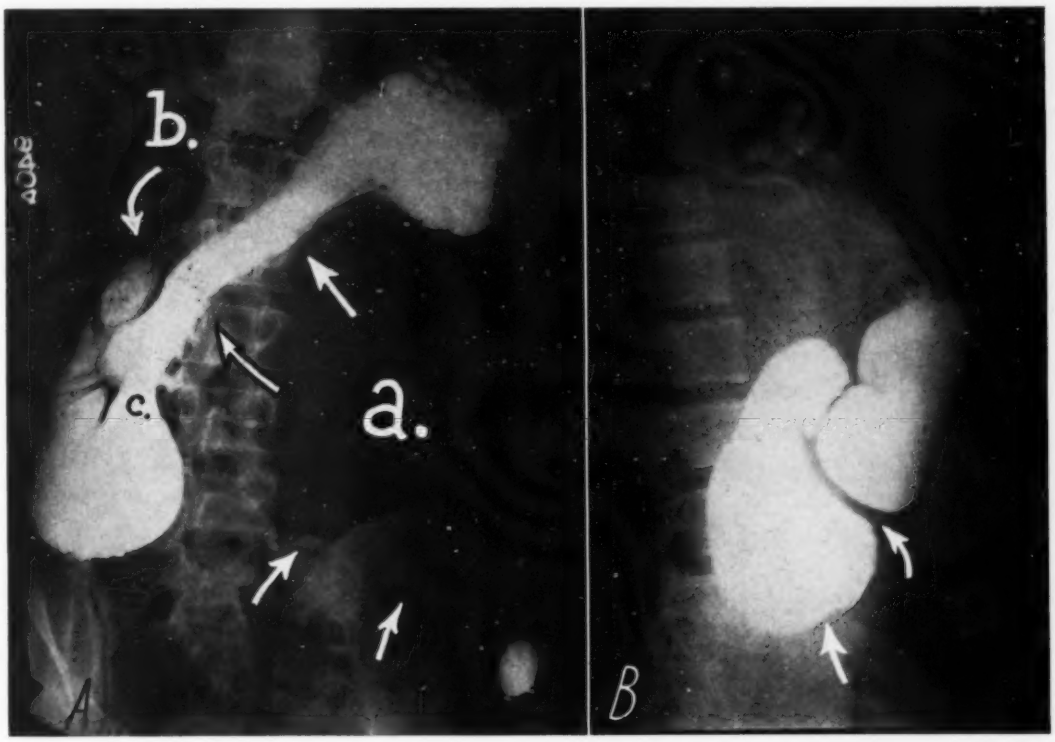

Fig. 36. Case xiv. Roentgenograms from a gastrointestinal examination showing marked cephalad and anterior displacement of the stomach with narrowing of the lumen. In *A*, a high degree of obstruction is shown in the region of the junction of the duodenum with the jejunum. The duodenum is markedly dilated. *a* and adjacent arrows indicate area of deformity in stomach; *b*, duodenal cap; *c*, region of obstruction. Lower arrows on left indicate lower margin of metastatic tumor causing the obstruction. *B*, lateral roentgenogram. Markedly dilated duodenum is indicated by arrows.

The patient developed rather severe nausea and vomiting while being given radiation therapy. It was at first thought that the symptoms were due to the irradiation, but they persisted and a gastrointestinal examination showed an almost complete obstruction in the region of

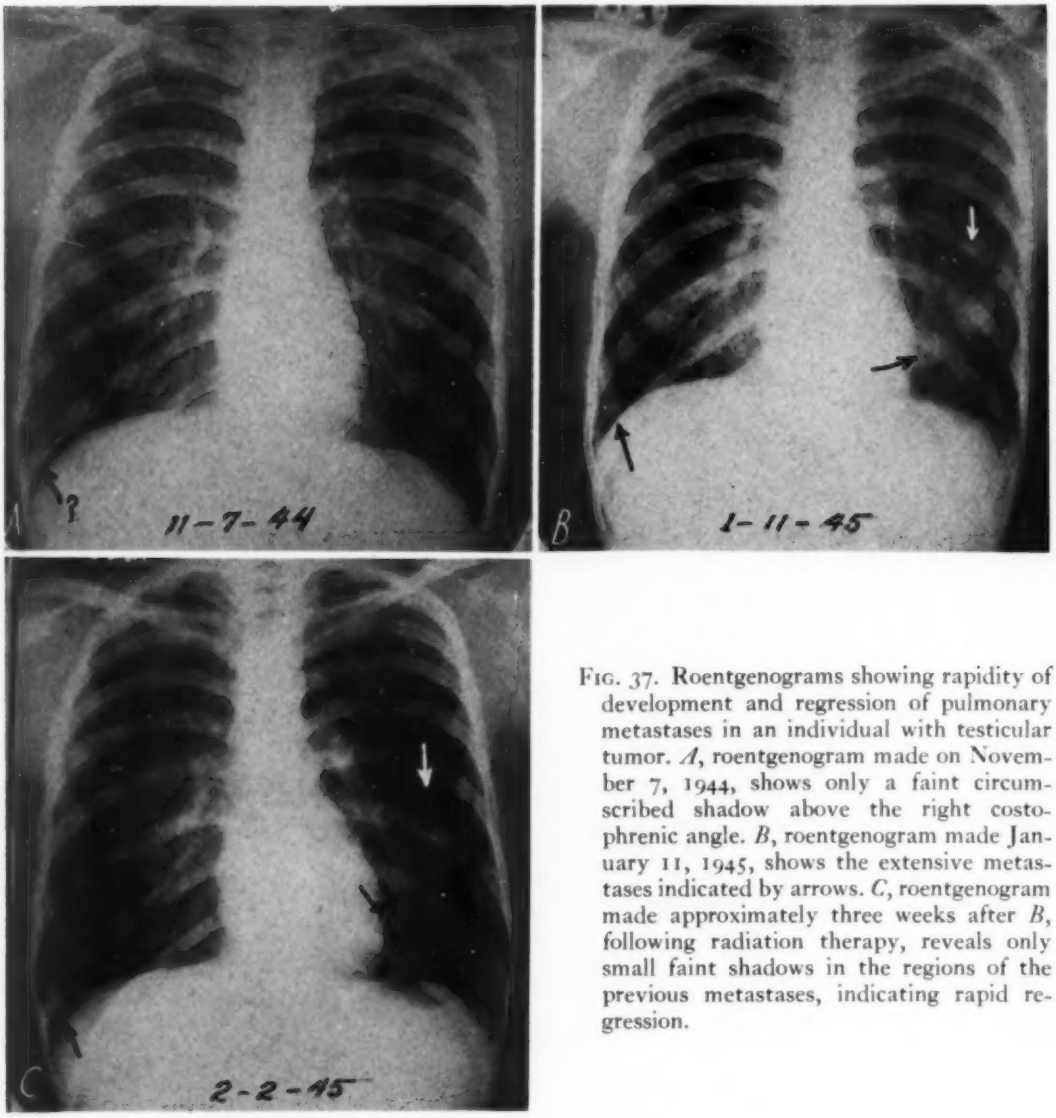

FIG. 37. Roentgenograms showing rapidity of development and regression of pulmonary metastases in an individual with testicular tumor. *A*, roentgenogram made on November 7, 1944, shows only a faint circumscribed shadow above the right costophrenic angle. *B*, roentgenogram made January 11, 1945, shows the extensive metastases indicated by arrows. *C*, roentgenogram made approximately three weeks after *B*, following radiation therapy, reveals only small faint shadows in the regions of the previous metastases, indicating rapid regression.

the duodenojejunal junction. The stomach was displaced anteriorly and cephalad. The findings are shown in Figure 36.

Operation revealed a very large retroperitoneal mass obstructing the small bowel in the region of the ligament of Treitz. An anterior gastroenterostomy and enteroenterostomy were done. Complete atelectasis of the left lung developed twenty-four hours postoperatively, but cleared promptly following bronchoscopy and aspiration. The postoperative course was otherwise uneventful.

Importance of repeated chest examinations deserves special emphasis. Metastases may appear and grow with great rapidity. Likewise they may regress promptly when suitable therapy is instituted. The above is well illustrated in Figure 37.

It is not within the scope of this paper to report in detail the findings in all the cases of testicular tumor that have been under our care during the past eighteen months. We are reporting briefly only a few representative cases in which the roentgen findings have been of importance in diagnosis, prognosis and in determining the plan of treatment.

THE LYMPHOMAS, INCLUDING HODGKIN'S DISEASE, AND THE LEUKEMIAS

In Percy Jones General and Convalescent Hospital, as a part of the general examination in all of the above conditions, the urinary tract is routinely surveyed. From the roentgen viewpoint, intravenous urography is done first and this is followed by a retrograde investigation when indicated. In the latter, again filling under roentgenoscopic guidance and lateral exposures have proved to be of value.

The findings in these cases differ only as a result of the different manifestations of these diseases. Lymphosarcomas can be demonstrated only if structures adjacent to some part of the urinary tract are involved and pressure defects or displacement result, a not infrequent occurrence.

In Hodgkin's disease one may see lesions that cause pressure defects, displacement and at times actual obstruction of various parts of the urinary tract. In our experience, the distal portions of the ureters have been involved instead of the proximal ureters and kidney pelves as has been the case in metastases from testicular tumors.

Case xv. This twenty-nine year old sergeant first noted severe pain in the right lower quadrant radiating down the leg in October, 1943. Two months later a firm mass appeared in the base of the neck and the patient was returned to the continental limits of the United States for further observation and treatment, a diagnosis of Hodgkin's disease having been made.

Physical examination upon admission to Percy Jones General and Convalescent Hospital in February, 1944, showed a large irregular tumor in the left supraclavicular area. A second mass was palpable in the right lower quadrant. There was an autosympathectomy of the right leg. Roentgenograms showed marked enlargement of the mediastinal lymph nodes near the arch of the aorta. An intravenous urogram showed obstruction of the right ureter near the junction of the proximal with the middle third. The obstruction corresponded to the upper margin of the palpable mass.

The chest findings are shown in Figure 38. In Figure 39 the obstruction of the right ureter is shown, indicated at *a*. This was a delayed urogram, relatively little of the opaque material remaining in the left side of the tract at this time. Figure 39*B* shows markedly improved function and drainage seventy-two days later following irradiation. There was no evidence of obstruction of the ureter at this time. Improvement was only temporary, however, and due to the widespread involvement the patient's course was rapidly retrogressive until death.

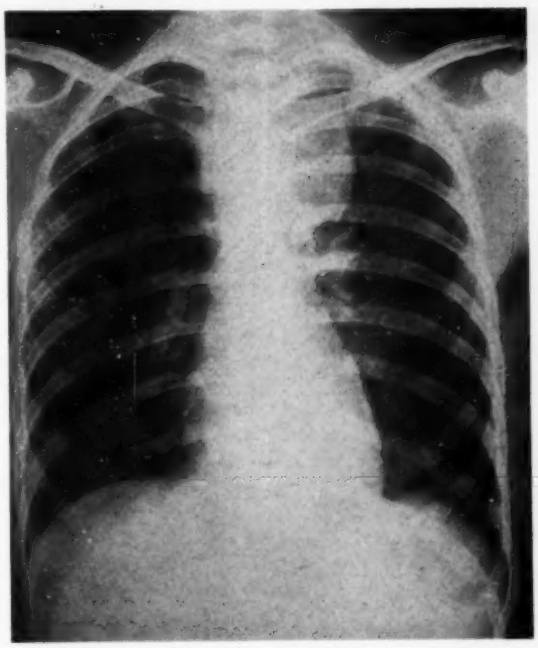

Fig. 38. Case xv. Hodgkin's disease. Roentgenogram of the chest showing left superior mediastinal tumor.

Case xvi. This private, aged twenty-eight, was well until August, 1943, when he developed a cough, did not feel well and began to lose weight. This was associated with a high fever. Two weeks later he noted a swelling in the right groin which increased in size quite rapidly. A biopsy of the enlarged glands in the neck was done overseas and a diagnosis of Hodgkin's disease made. He was given radiation therapy overseas, with regression of the enlarged lymph nodes and improvement in his general condition. He was admitted to this hospital for further radiation therapy.

An intravenous examination of the urinary tract showed marked medial displacement of the distal portion of the right ureter and ante-

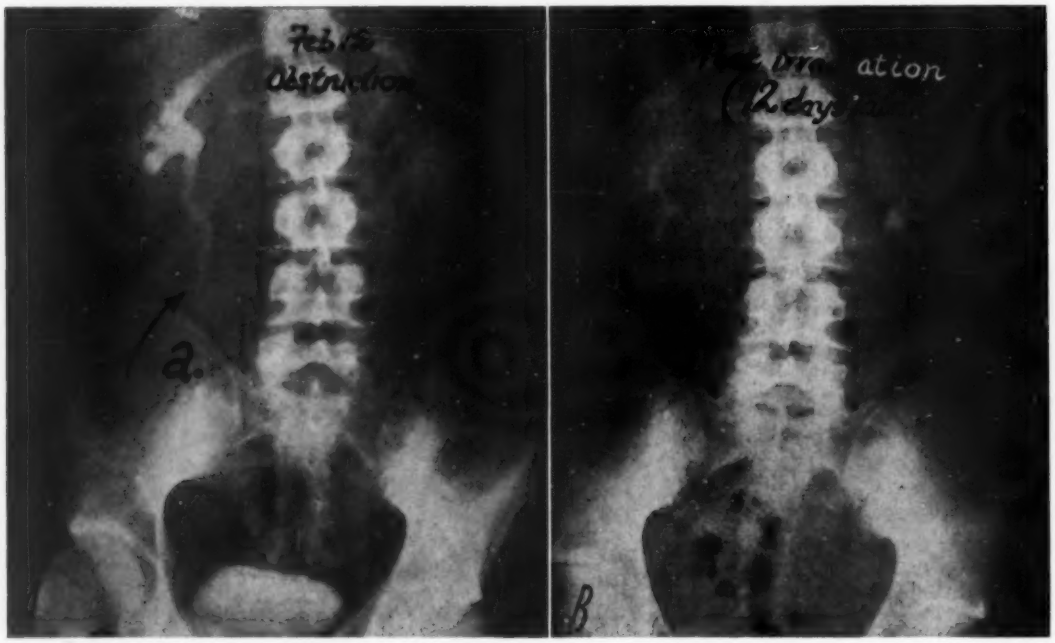

FIG. 39. Case XV. Hodgkin's disease. *A*, thirty minute intravenous urogram. It shows a rather high degree of obstruction at *a*. The excretion and drainage on the left were normal. *B* shows normal excretion and drainage on both sides seventy-two days later following irradiation.

FIG. 40. Case XVI. Hodgkin's disease. Medial and anterior displacement of the ureter indicated at points *a* and *b*. There was no clinical evidence of metastatic disease within the abdomen at the time of this examination and no palpable mass had been detected during physical examination.

rior displacement of the distal two-thirds of the ureter as well. A large tumor could be palpated in the region of the displaced ureter. The findings at retrograde examination of the right side of the urinary tract are shown in Figure 40. The area of medial displacement of the ureter is shown at *a* and the area of anterior displacement at *b*.

The patient has been given heavy radiation therapy to many fields. The response to treatment was satisfactory and at the time of separation from service the patient was in excellent general condition.

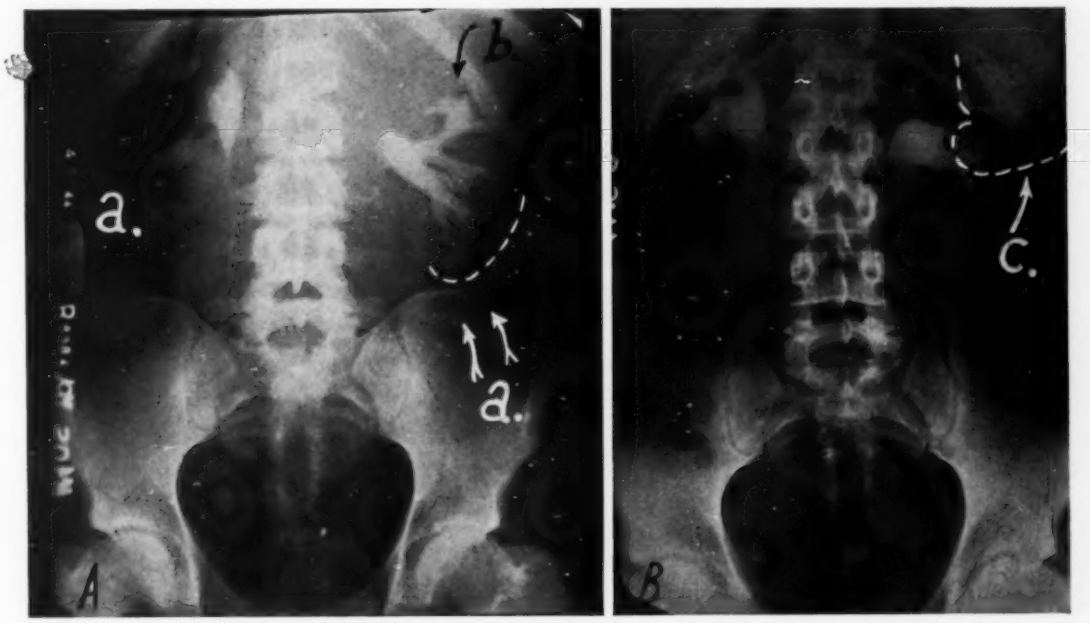

Fig. 41. Case xvii. Chronic myelogenous leukemia. *A*, twenty minute intravenous urogram. The left kidney shadow shown at *b* is obviously markedly enlarged and is displaced downward and rotated. There was some enlargement of the kidney pelvis and calices on the right. The lower and right lateral margins of a greatly enlarged spleen are shown at points *a*. *B*, fifteen minute intravenous urogram made four months after *A*. The lower margin of the spleen outlined at *c* is now near the costal margin. The kidneys are smaller than before. The rotation on the left has decreased. Some stasis is probably present.

In the leukemias, the left kidney may be displaced downward by a markedly enlarged spleen and such displacement may result in interference with drainage (Fig. 41). The frequency with which leukemic invasion of the kidney parenchyma takes place is generally known. Kirshbaum and Preuss[3] report 63 per cent of kidneys involved by all forms of leukemia at necropsy. One may suspect the presence of such invasion because of changes seen in urograms characterized by enlargement of the kidney shadow and enlargement and/or deformity of the pelvis and calices. Our opinions regarding leukemic invasion of the kidney parenchyma have not been confirmed at autopsy in all cases, however. It would seem that congestive changes may play an important rôle in the apparent renal enlargement seen during intravenous urography. Such an appearance may simulate changes due to actual leukemic invasion of the kidney parenchyma.

Case xvii. A male, aged twenty-two, was admitted with a history of weakness and shortness of breath, loss of appetite and a feeling of fullness in the left upper abdomen. The symptoms were first noted in December, 1943, when on maneuvers. Weakness, loss of appetite and night sweats became marked while on duty overseas.

Physical examination showed a large firm mass in the left upper quadrant extending down

to the level of the iliac crest. It was obviously a very markedly enlarged spleen.

Blood examination revealed 3,050,000 red cells and 587,000 white cells. The differential count at this time showed 2 per cent myeloblasts, 13 per cent promyelocytes, 18 per cent neutrophilic myelocytes, 16 per cent metamyelocytes, 24 per cent stabs, 12 per cent segmented forms, 5 per cent eosinophiles, 3 per cent eosinophilic myelocytes, 6 per cent basophilic myelocytes, 1 per cent mononuclear cells. The diagnosis of chronic myelocytic leukemia was obvious. Radiation therapy was given with progressive improvement, the blood findings returning to normal.

An intravenous examination of the urinary tract upon admission showed marked downward displacement of the left kidney due to a greatly enlarged spleen. The kidney was enlarged and the pelvis and calices dilated. The findings are shown in Figure 41, the border of the spleen being indicated at *a* and the enlarged and displaced left kidney at *b*. The change in the size of the spleen following radiation therapy and the improvement in the appearance and position of the left kidney are indicated at *c*.

COMMENT

1. The intravenous urogram is an important diagnostic aid in the study of urinary tract disease of many types.

2. It is an examination that requires careful supervision by one thoroughly familiar with the indications for its use, its limitations and the technical requirements of the examination.

3. The intravenous and retrograde methods of examination are not competitive, but are complementary.

4. Retrograde filling of the urinary tract under roentgenoscopic guidance should be resorted to more often than has been done heretofore.

5. Roentgenograms of the urinary tract made in the lateral projection are of decided aid in diagnosis when indicated.

6. In individuals with testicular tumors, the earliest demonstrable metastases are frequently in the region of the renal pedicles. Intravenous urography is of primary importance in these cases not only in demonstration of metastases, but in prognosis and in the determination of the results of therapy as well.

7. Attention is directed to the fact that primary testicular tumors may be very small and remain so even when large metastatic masses are present elsewhere.

REFERENCES

1. ARCHER, V. W., and HARRIS, I. D. Ocular test for sensitivity to diodrast prior to intravenous urography. AM. J. ROENTGENOL. & RAD. THERAPY, 1942, *48*, 763–765.
2. CHAMBERLIN, G. W., and JAMISON, J. H. Treatment of malignant tumors of the testis. AM. J. ROENTGENOL. & RAD. THERAPY, 1941, *46*, 850–865.
3. KIRSHBAUM, J. D., and PREUSS, F. S. Leukemia; clinical and pathologic study of 123 fatal cases in a series of 14,400 necropsies. *Arch. Int. Med.*, 1943, *71*, 777–792.
4. MANGES, W. F. Pyeloscopy. AM. J. ROENTGENOL., 1918, *5*, 165–173.
5. MERTZ, H. O., and HAMER, H. G. Lateral pyelogram: investigation of its value in urologic diagnosis. *J. Urol.*, 1934, *31*, 23–55.
6. NASH, L. A., and LEDDY, E. T. Seminoma of testis from standpoint of roentgen treatment. AM. J. ROENTGENOL. & RAD. THERAPY, 1943, *50*, 162–196.
7. PENDERGRASS, E. P., CHAMBERLIN, G. W., GODFREY, E. W., and BURDICK, E. D. Survey of deaths and unfavorable sequelae following administration of contrast media. AM. J. ROENTGENOL. & RAD. THERAPY, 1942, *48*, 741–762.
8. RANDALL, A. Irradiation control of testicular tumor metastases; return of renal function after long apparent absence. *J. Urol.*, 1941, *46*, 1144–1148.
9. SHIFLETT, E. L., and KEITH, D. Y. Lateral pyelography. AM. J. ROENTGENOL. & RAD. THERAPY, 1940, *43*, 664–672.

Vol. 53, No. 6

AEROSINUSITIS

A CLINICO-ROENTGENOLOGICAL STUDY

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AMONG the problems peculiar to aviation medicine are otorhinological affections caused directly by the action of rapid changes of barometric pressure on aviators during flight and on personnel in altitude chambers. Such individuals may be transported rapidly from low to high barometric pressures or from high to low pressures. These changes are reflected more or less closely in the paranasal sinuses and in the middle ear, which are connected to the nose and nasopharynx by relatively narrow passageways. An equilibrium tends to be maintained thereby between atmospheric pressure in the environment and nares on the one hand, and in the paranasal sinuses and middle ear, on the other hand. Because their passageways are small and often display anatomical variations in size and shape, it is not surprising that such radical barometric changes may call forth unusual responses in these structures. Thus, blockage of the eustachian tube, leading to a relatively negative pressure in the middle ear, causes the well known syndrome of aero-otitis media with its attendant edema and transudation or hemorrhage.[1,2] This condition has recently been the subject of roentgenological investigation by Larkin.[5]

A search of the literature fails to reveal a clinico-roentgenological study of aerosinusitis, an entity which is very similar to aero-otitis media in its inception and course, and whose probable mechanism has been described by Campbell.[3] There has been no study of the gross or microscopic pathology of aerosinusitis as yet. Clinical and roentgenological evidence indicates, however, that mucosal edema, transudation and even hemorrhage may occur in a sinus whose ostium is apparently blocked suddenly by a mucous plug or redundant mucosa, while the affected individual is descending from altitude, real or simulated. This disorder is by no means frequent during flight or chamber runs, but its occurrence and ensuing disability are sufficient to make it a subject of importance in aviation medicine.

ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS

The paranasal sinuses are outpouchings of the nasal portions of the respiratory tract and expand into air-containing recesses. They retain their connections to the nasal passages by ostia or ducts, which are usually small. These connections may be somewhat indirect, as in the often tortuous, narrow nasofrontal ducts. They are sometimes at a level well above the floors of the corresponding sinuses (notably the maxillary and posterior ethmoid sinuses) and thereby tend to impede drainage. Since the risk of blockage would seem to be greater in a duct or canal than in a simple ostium, it may be that the demonstration of aerosinusitis only in the frontal and maxillary sinuses is at least partly accounted for by the existence of the nasofrontal duct in the frontal sinus, and by the possible presence of a maxillary canal, rather than only an ostium, in many maxillary sinuses.[8] It is possible, of course, that involvement of the other paranasal sinuses by this disorder may occur and be unrecognized as yet.

Drainage of the accessory sinuses is normally dependent on gravity, on the ciliary activity of their mucosal membrane and on the continuity of the mucus of the nose and sinuses. They are lined by a delicate mucosa supplied by a rich network of capillaries and lymphatics, and so intimately

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† Acknowledgment is extended to Major Benjamin Herzberg for his aid in preparing some of the reproductions.

applied to the bony walls[6] that the term "mucoperiosteum" is more descriptive. This intimate alliance of the mucoperiosteum and sinus walls, and the richness of the vascular bed, have important bearing on the symptoms and signs of aerosinusitis.

From the foregoing observations, several concepts may be developed:

1. The patency of the sinus ostium, duct or canal is essential to the free interchange of air between a sinus and the nasal passage. Obstruction to an ostium may therefore create a pressure imbalance between environment and sinus, with the intrasinus pressure negative in relation to the external atmospheric pressure.

2. Sudden development of increasing negative pressure in a sinus, sufficient to cause stretching and ballooning of the mucosa, would tend to traumatize its network of blood vessels and lymphatics and could conceivably lead to mucosal edema and hemorrhage.

3. The frontal sinuses, and those maxillary sinuses which may have canals rather than ostia, would be especially susceptible to blockage.

4. Under certain unfavorable conditions, nasal secretions may be forced into the accessory sinuses through patent ostia,[3] and if infected might in turn cause a catarrhal or purulent sinusitis. Particularly susceptible are sinuses already handicapped by disadvantageous location of their ostia and with residual mucosal damage from previous infection. Experimental evidence indicates that healthy sinuses are resistant to infection by aspiration. It should be noted at this time that ordinarily the atmospheric pressures in the nose and sinuses are equal or approximately equal,[9] but Proetz[7] and later Judd[4] showed that a time lag exists during equalization of changing intra- and extrasinus pressures. It seems likely that such a time lag may be prolonged as descent from high altitude proceeds uninterruptedly, and the pressure differential between the sinuses and nasal passages may thereby be progressively increased. In turn, the increasing pressure gradient might provide sufficient force to introduce nasal secretions into a sinus and set up a sinusitis if mucosal damage in the sinus already exists. This succession of events might also produce prodromal conditions conducive to the abrupt occurrence of aerosinusitis if sudden ostial blockage were superimposed.

COURSE

An aviator in flight, descending from high to lower altitude, enters regions of successive greater atmospheric pressure. The same progression occurs in the case of the individual "descending" in the altitude chamber. At higher altitudes, decreased atmospheric pressure exists in the environment, nasal passages and sinuses. Normal relationships must be maintained during descent by free ingress of air into the sinuses, in order to balance intrasinus pressure with that of the environment. However, an ostium may be completely occluded by impingement of a small flap of redundant nasal mucous membrane or a thick mucous plug, due to the pressure of the inflowing air and the pressure differential between the sinus cavity and nasal passage. The presence of swollen, edematous nasal mucosa may facilitate such occlusion, particularly if adjacent to or actually involving an ostium. With the ostium occluded and descent continuing, the pressure differential between the nasal passage and the affected sinus rapidly increases. An attempt to equalize this gradient is called forth and, with no immediate way of re-establishing patency of the ostium, the volume of the intrasinus cavity must be decreased in order to maintain normal pressure of the contained gas (Boyle's law). This decrease is effected by a marked swelling of the lining membrane. The mucosal swelling is attributed to edema, and may be accompanied by transudation or hemorrhage, sometimes with formation of a mucosal hematoma and bloody discharge later from the affected sinus.

If hemorrhage occurs, it must follow rup-

ture of some of the tiny vessels with which the sinus mucosa is abundantly supplied. Frank bleeding may then be caused by seepage from a hematoma, or damage to the continuity of the mucous membrane. The initial trauma to the blood vessels is apparently of the same origin as that which causes the edema of the mucosa: the partial intrasinus vacuum and the increasing pressure differential between the sinus and nasal passage. It may then be assumed that the difference between the trauma causing edema and that causing hemorrhage is one of degree, or that variations in resistance of the local blood vessels and lymphatics account for the different results. Thus, previous insult to the sinus mucosa (e.g., by infection) may leave its structures less resistant to such trauma. At any rate, the direct etiological factor appears to be the pressure gradient. Its effect might be termed "barometric trauma" to the sinus mucosa.

Granting the possibility of aspiration of the infected nasal secretions into a sinus against normal ciliary activity,[3] it seems reasonable that a sinusitis may be induced, particularly if the mucosa has been traumatized by previous infection. I believe this sequence is illustrated in Case VIII in this series. If granted, this example serves to illustrate the development of an infective sinusitis by flight, in occasional cases. If flying in the presence of a rhinitis were not discouraged, this type of case might be observed with greater frequency.

SYMPTOMS AND SIGNS

Aerosinusitis is manifested generally by a sudden, severe, unremitting pain, boring in character and localized over the region of the affected sinus. The pain occurs abruptly during descent from regions of low atmospheric pressure in aircraft or chamber. Conceivably, the mechanism of this pain may be due to sudden stretching and separation of the mucoperiosteal tissues during the rapid swelling that follows plugging of the ostium.

Not all the mucosa of an involved sinus may become swollen; bulky swelling of only part of the lining occurs often and presumably is limited by more rigid binding of the mucoperiosteum at the partial septa and at the angles between adjacent walls of the sinuses. Such swelling, easily demonstrated roentgenographically, may be edema or hematoma, and in either case, may be accompanied by transudation of fluid. It is not easy to differentiate edema from hematoma by the roentgenogram alone. The later appearance of dark red or brownish mucus, or even clots, establishes the presence of blood in the affected sinus, and may be the result of frank bleeding from the mucosa or seepage from a hematoma. The blood may remain in the sinus for a considerable period if patency of the ostium is difficult to establish, or early bleeding may occur when the obstruction can be relieved quickly.

Although the changes in the bony walls that are seen in the roentgenogram in chronic infective or chronic allergic sinusitis are not present in aerosinusitis, the latter would not be distinguishable from an acute allergic or infective sinusitis without the benefit of an adequate history and rhinological examination. Difficulty may be experienced also if an aerosinusitis is superimposed on an already diseased or traumatized sinus. These considerations emphasize the need for cooperation between the roentgenologist and the clinician in evaluating each case.

TREATMENT

Although the scope of this article is primarily diagnostic, it may not be amiss to mention briefly the treatment of aerosinusitis. The severe pain may be partly relieved sometimes by immediate re-ascent to higher altitude followed by slow descent. Thereafter, persistent and continuous shrinkage of the nasal mucosa at the ostium of the affected sinus is the only effective method, with use of a vasoconstrictor applied by spray or topical packs. The more prompt the re-establishment of ostial patency, the more rapid is the resolution of

the aerosinusitis. The neglected or incompletely treated case may be disabled for weeks. Symptomatic treatment consists of the use of external heat and small doses of codeine, and contributes to the comfort of the patient. Flying or altitude chamber excursions should be prohibited at least until beginning resolution is revealed by the roentgenogram. Total resolution is demonstrated by complete return to normal appearance of the sinus roentgenogram, which seems always to follow clinical subsidence. The superimposition of an aerosinusitis on a chronic infective or allergic sinusitis might prolong resolution further. The resumption of flying duty before complete clearing may be a matter of clinical judgment or may be justified in time of war by contingent factors of urgency.

REPORT OF CASES

CASE I. This aviator flew on November 24, 1943. He developed acute pain over the right cheek during descent and the pain persisted on the ground for several hours. There was no bleeding. Nasal examination was essentially normal. Relief of pain was obtained after several instillations of a vasoconstrictor. There was no fever or other evidence of an infective process.

Previous History. No sinusitis or chronic rhinitis.

Roentgen Findings. November 26, 1943 (Fig. 1*A*): Mucosal swelling is obvious in the right antrum involving all the walls. March 4, 1944 (Fig. 1*B*): The right antrum now displays a normal appearance.

Comment. This case represents aerosinusitis of a relatively mild type, without evidence of sufficient trauma to cause bleeding, and with rapid clinical response to simple treatment.

CASE II. While "descending" in the altitude chamber on June 1, 1944, this man developed extremely severe right frontal pain only slightly relieved by temporarily "ascending." The frontal pain persisted all day and bleeding occurred from the nose or nasopharynx into the throat in the evening. At the hospital that evening bilateral aero-otitis media was also found, more severe on the right side, with slight bloody oozing from the nose. A vasoconstrictor was applied topically to the ostium of the right nasofrontal duct and there followed a mucosanguineous discharge from the duct. The patient improved progressively with constant shrinkage therapy. There was no laboratory evidence of blood dyscrasia.

Previous History. No sinusitis or chronic rhinitis.

Roentgen Findings. June 2, 1944 (Fig. 2*A*): There is bulky mucosal swelling (hematoma?) in the right frontal sinus and moderate swelling in the medial portion of the left frontal sinus. June 5, 1944 (Fig. 2*B*) and June 6, 1944 (Fig. 2*C*): There is increased mucosal swelling in both frontal sinuses, particularly the right, which displayed a fluid level. July 17, 1944 (Fig. 2*D*): There is well advanced resolution of the sinusitis in the right frontal sinus with appreciable residual thickening of the mucosal shadow along

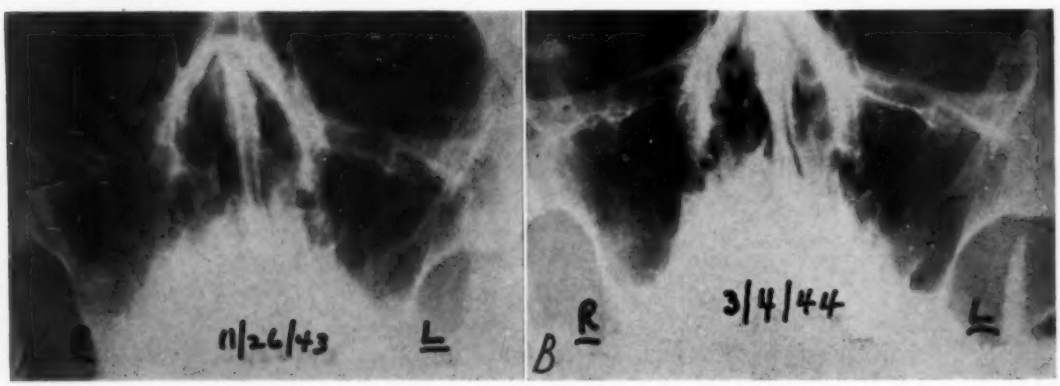

FIG. 1. Case I. *A*, November 26, 1943. Mucosal swelling in the right antrum, involving all the walls. *B*, March 4, 1944. Both antra are now clear.

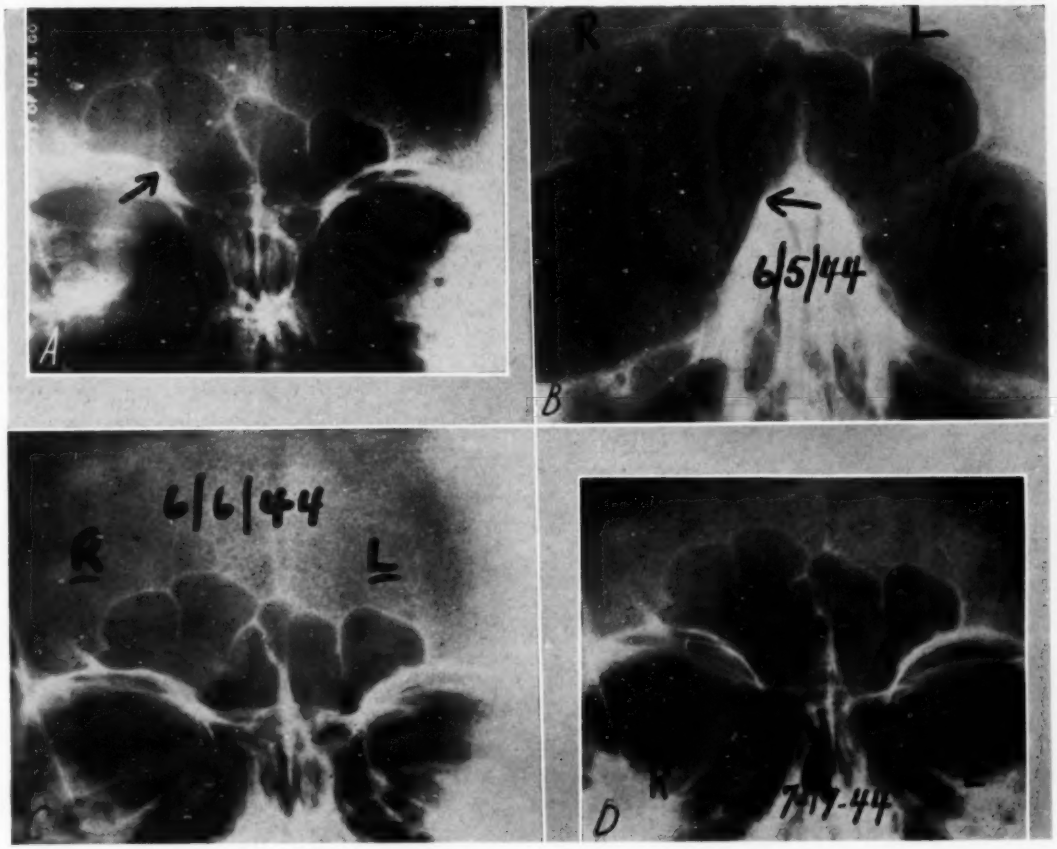

Fig. 2. Case II. *A*, June 2, 1944. Severe mucosal swelling in the right frontal sinus may be hematoma. There is haziness below the area of swelling, apparently due to free fluid (shown in *B*). The medial wall of the left frontal sinus shows some mucosal thickening also. *B*, June 5, 1944. Upright Waters position demonstrates a fluid level (arrow) in the right frontal sinus. *C*, June 6, 1944. The free fluid in the right frontal sinus has apparently now been drained, disclosing the bulky mucosal swelling in sharper contrast and slightly greater size. *D*, July 17, 1944. Almost complete resolution of the process in each frontal sinus. There is still some mucosal thickening in the right frontal sinus, but the bulky shadow is absent.

the lateral wall and roof, and mild persistent clouding of the left frontal sinus.

Comment. A complicating aero-otitis media occurred in this case but the existence of blood in the right frontal sinus was established following shrinkage about the ostium of the right nasofrontal duct. It is probable that the bullous swelling in the right frontal sinus, demonstrated roentgenographically, was a mucosal hematoma.

Case III. On August 15, 1943, this soldier experienced excruciating pain over the left brow while "descending" in the altitude chamber. The nasal mucosa appeared normal on physical examination. A bloody discharge from the left naris appeared the next day and continued with occasional small clots for several days. The pain subsided slowly with intranasal vasoconstrictor therapy.

Previous History. Non-contributory. Nose clear to examination.

Roentgen Findings. August 16, 1943 (Fig. 3*A*): A bulky mucosal swelling (hematoma?) appears in the left frontal sinus with no fluid level. March 25, 1944 (Fig. 3*B*): Normal appearance of the frontal sinuses is demonstrated.

Comment. The progress of resolution could not be followed in this case, unfortunately. The second roentgenogram is

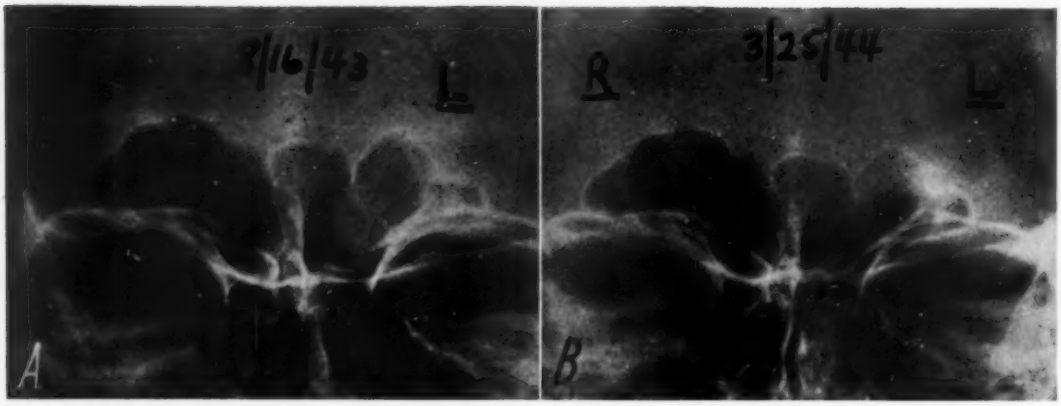

FIG. 3. Case III. *A*, August 16, 1943. The bulky shadow in the left frontal sinus is well demonstrated. *B*, March 25, 1944. Normal appearance of the frontal sinuses.

shown to indicate the normal appearance of the frontal sinuses at a later date. Here again, the bloody discharge is evidence to suggest that the left frontal sinus contained a mucosal hematoma.

CASE IV. During "descent" in the altitude chamber on March 3, 1943, stabbing pain was experienced over the left cheek bone radiating toward the nose. The pain persisted about twenty-four hours, subsiding under treatment.

Previous History. No chronic rhinitis or sinusitis; no history of allergy.

Roentgen Findings. March 3, 1943 (Fig. 4*A*): Bulky mucosal swelling is visualized in the left antrum. March 11, 1943 (Fig. 4*B*): Both antra are now radiant. (This individual has had two subsequent attacks of aerosinusitis, one in the left antrum and one in the right, with bloody discharge during the course of the left antral aerosinusitis; both these episodes occurred during "descent" in the altitude chamber.)

Comment. In the absence of any evidence of chronic nasal or sinus disease, it is interesting that this soldier experienced several attacks of aerosinusitis of the antra. The pain was as severe as any I have seen but response to conservative treatment was reasonably prompt. Bleeding occurred only during the course of the second episode af-

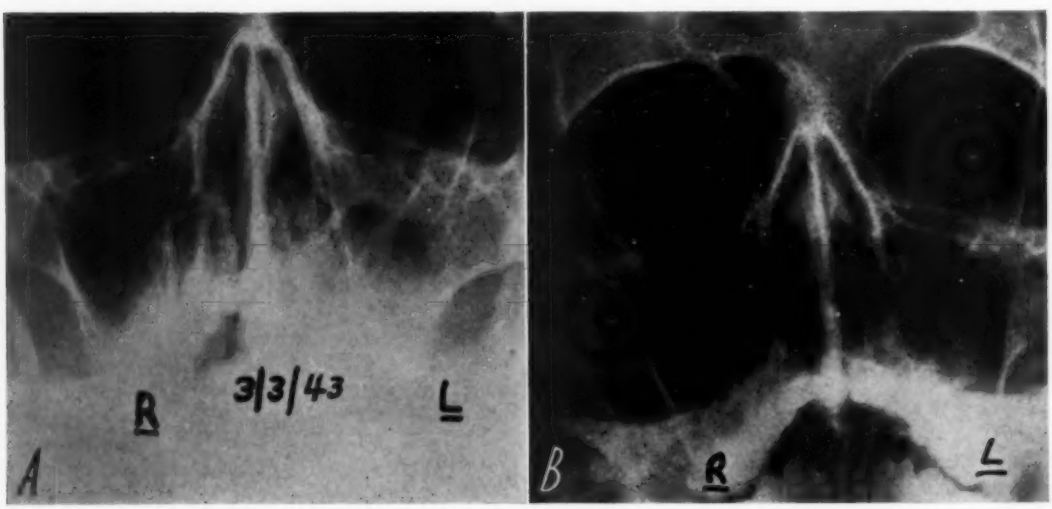

FIG. 4. Case IV. *A*, March 3, 1943. Generalized bullous mucosal swelling in the left antrum. *B*, March 11, 1943. Rapid resolution is apparent, with the left antrum now radiant.

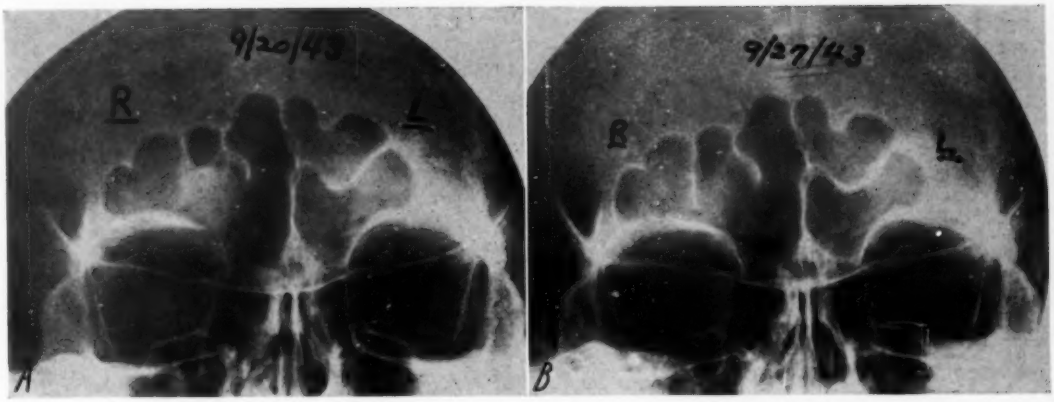

Fig. 5. Case v. *A*, September 20, 1943. A bullous mucosal shadow is in the right frontal sinus, and the left frontal sinus is hazy. *B*, September 27, 1943. The mucosal swelling in the right frontal sinus is smaller; apparently absorption is taking place.

fecting the left antrum. This may have been an effect of the residual mucosal damage following the first episode described above, or it may have been due to a possible difference in degree of the pressure differentials established.

Case v. During descent in an airplane, there was a sudden pain over the right brow accompanied by moderate, dull pain over the left frontal sinus. The pain was completely relieved in forty-eight hours with intranasal vasoconstrictor therapy. On examination, there was a slight mucoid discharge from the right nasofrontal duct, but the nose was otherwise clear.

Previous History. No history of allergy, chronic rhinitis or sinusitis.

Roentgen Findings. September 20, 1943, (Fig. 5*A*): There is haziness of the left frontal sinus and a sharply demarcated, bulky mucosal swelling in the right frontal sinus. No fluid level was demonstrable in either sinus. September 27, 1943 (Fig. 5*B*): There is a sharp decrease in the extent of mucosal swelling in the right frontal sinus and improvement in the appearance of the left frontal sinus. (Further follow-up not available.)

Comment. The occurrence of changes in both frontal sinuses, demonstrated in this case and in Case ii, is unusual. There was apparently a marked quantitative difference in the reaction as demonstrated roentgenographically, with a milder but more

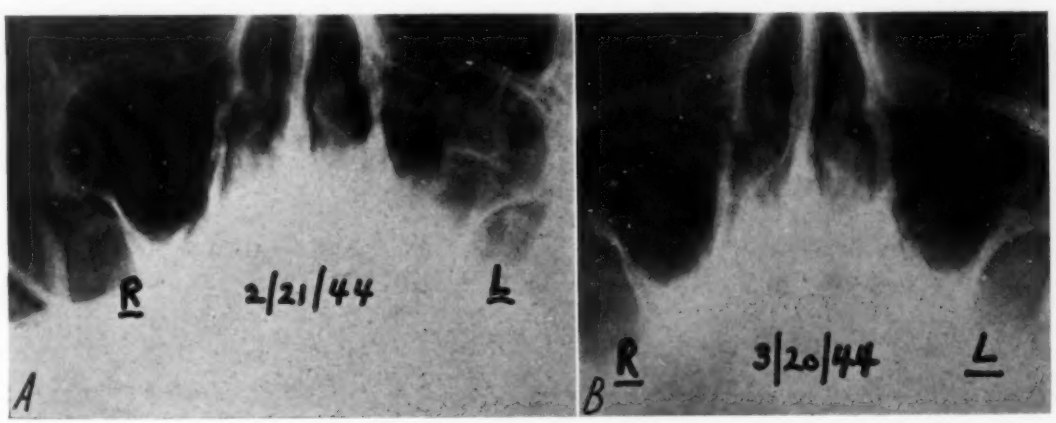

Fig. 6. Case vi. *A*, February 21, 1944. Obvious and severe mucosal thickening involves the left antrum. *B*, March 20, 1944. The antra are radiant.

generalized mucosal thickening in the left frontal sinus. It may be observed, speculatively, that such a bilateral occurrence may be due to particularly marked narrowness or tortuosity of the nasofrontal ducts in these individuals.

CASE VI. Acute pain over the left malar prominence occurred suddenly and radiated to the left maxilla during descent in an airplane on February 20, 1944. The sharp pain persisted for twenty-four hours and gradually subsided thereafter under treatment. The nose was clear on examination.

Previous History. Non-contributory.

Roentgen Findings. February 21, 1944 (Fig. 6*A*): Hyperplastic mucosal changes in the left antrum are visualized. March 20, 1944 (Fig. 6*B*): The left antrum is completely clear.

Comment. This is a typical and clear-cut case of aerosinusitis in one antrum.

CASE VII. During an airplane flight on June 13, 1944, this young aviator experienced a sudden, excruciating pain over the left brow radiating to the internal canthus of the left eye. The pain partially subsided and the next day he flew again, only to suffer a recurrence of the attack. He reported to the hospital then and was treated with a vasoconstrictor applied by topical pack and nose drops, supplemented by physiotherapy. Under this treatment his pain subsided slowly and was completely relieved in seventy-two hours. A yellowish mucoid discharge occurred from the left naris on June 18, 1944.

Previous History. Non-contributory.

Roentgen Findings. June 14, 1944 (Fig. 7*A*): There is a band of mucosal swelling across the floor of the left frontal sinus. June 17, 1944 (Fig. 7*B*): The mucosal swelling in the floor of the left frontal sinus is persistent. June 30, 1944 (Fig. 7*C*): The mucosal swelling previously visualized is now absent.

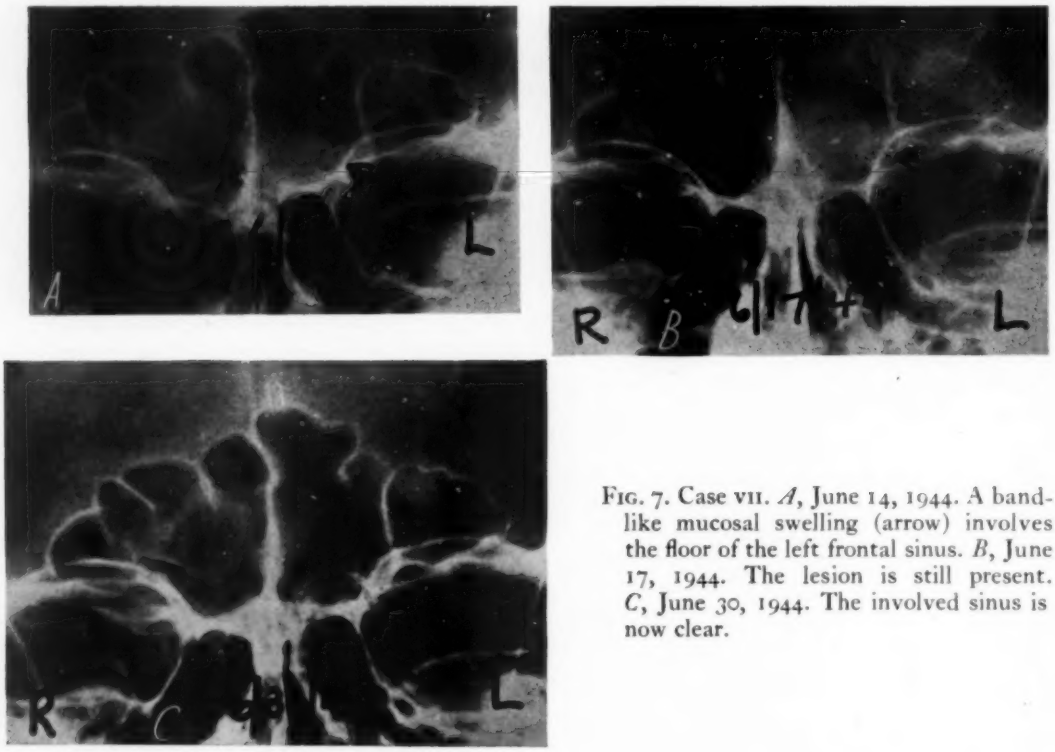

FIG. 7. Case VII. *A*, June 14, 1944. A band-like mucosal swelling (arrow) involves the floor of the left frontal sinus. *B*, June 17, 1944. The lesion is still present. *C*, June 30, 1944. The involved sinus is now clear.

Comment. A recurrent attack of aerosinusitis in twenty-four hours is uncommon inasmuch as medical attention is usually sought as soon as possible. This flyer, anxious to lose no flying time, unfortunately exposed himself to the recurrence which brought him to the hospital. Although his

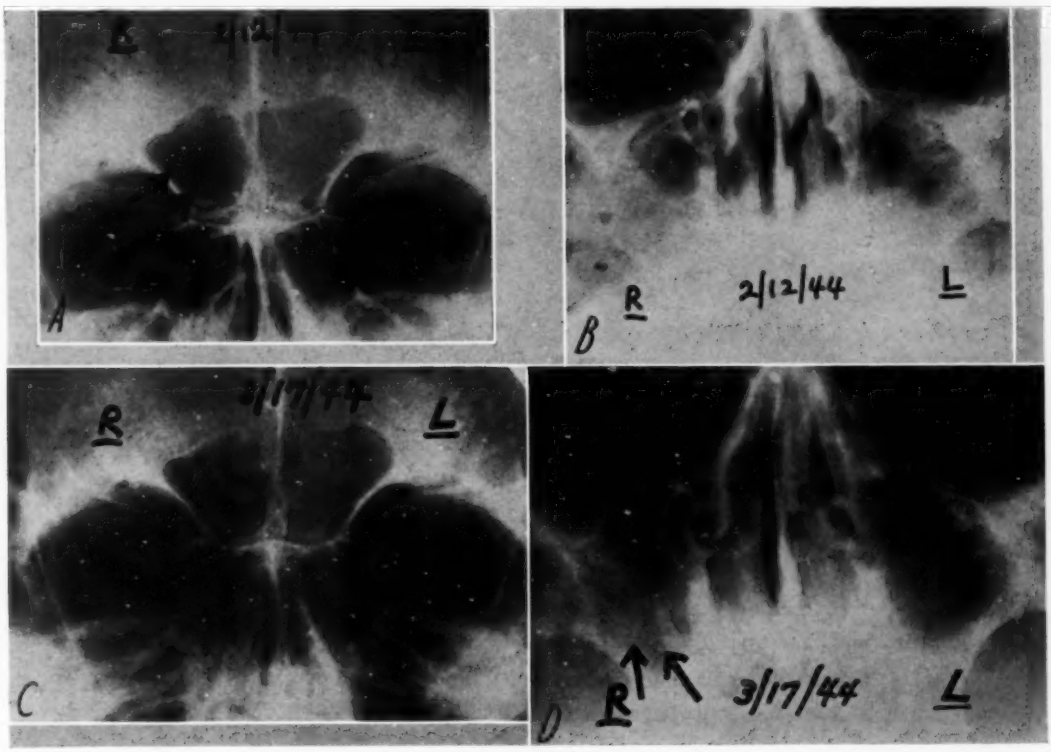

Fig. 8. Case VIII. *A* and *B*, February 12, 1944. A hyperplastic sinusitis involves the frontal and maxillary sinuses. The left frontal sinus is almost opaque; the right frontal sinus displays bulky mucosal swelling on the roof and medial wall (arrows). *C* and *D*, March 17, 1944. Considerable resolution has occurred but there is still mucosal swelling in the right antrum (arrows) and haziness in the left frontal sinus.

pain persisted for three days before complete relief was obtained, roentgenographic clearing of the affected sinus was evident in about two weeks.

Case VIII. This officer flew on February 10, 1944, despite a mild rhinitis. During descent an aching sensation occurred, localized over both antra and brows. A febrile course ensued in the hospital, with a mucopurulent bilateral nasal discharge, and gradual improvement under conservative measures. A rhinitis was apparent to physical examination.

Previous History. There had been several episodes of sinusitis before this patient began to fly. The most recent attack occurred some two years ago. There was no history of allergy.

Roentgen Findings. February 12, 1944 (Fig. 8*A*): There is marked mucosal thickening in the antra and frontal sinuses. March 17, 1944 (Fig. 8*B*): The appearance of the involved sinuses is greatly improved, but the right antrum displays residual mucosal swelling along its lateral and medial walls. The left frontal sinus displays haziness which may be residual or chronic. The left antrum and right frontal sinus are clear.

Comment. The atypical onset, febrile course, mucopurulent nasal discharge and history of previous sinusitis suggest that this case may represent a sinusitis induced by aspiration of infected nasal secretions in the presence of an acute rhinitis (see text).

SUMMARY

1. Aerosinusitis is a traumatic affection of the paranasal sinuses, characterized by dramatic, sudden, severe pain localized over the affected sinuses and occurring during descent from altitude in an aircraft or altitude chamber.

2. Its immediate cause is apparently sudden obstruction of a sinus ostium, as by a mucous plug or loose mucosal membrane, thereby sharply and radically increasing

the relatively negative intrasinus pressure which presumably exists already in the sinus during descent.

3. The intense pain of this condition is attributed to sudden ballooning of the sinus mucoperiosteum induced by the great negative pressure. Edema and transudation in the sinus may occur and may be accompanied by hematoma and/or frank hemorrhage.

4. The roentgenographical appearance and the history are characteristic in this disorder, as illustrated by the appended case histories and serial roentgenograms.

5. It is also possible that the pressure gradient may lead to an infective sinusitis by forcing aspiration of infected nasal secretions into a sinus previously damaged by infection.

6. Aerosinusitis is a subject of importance in aviation medicine. It results in loss of man-hours and may jeopardize safety by the intense and even agonizing discomfort during aerial flight.

REFERENCES

1. ARMSTRONG, H. G., and HEIM, J. W. Effect of flight on middle ear. *J. Am. M. Ass.*, 1937, *109*, 417–421.
2. ARMSTRONG, H. G. Principles and Practice of Aviation Medicine. Second edition. William Wood & Co., Baltimore, 1943, pp. 211–228.
3. CAMPBELL, P. A. Aerosinusitis. *Arch. Otolaryng.*, 1942, *35*, 107–114.
4. JUDD, D. K. Air pressures in nose and maxillary sinus under normal conditions and in disease. *Ann. Otol., Rhin. & Laryng.*, 1942, *51*, 689–703.
5. LARKIN, J. C. Aero-otitis media; roentgenologic study. AM. J. ROENTGENOL. & RAD. THERAPY, 1944, *51*, 178–185.
6. MAXIMOW, A. A., and BLOOM, W. A Textbook of Histology. Fourth edition. W. B. Saunders Co., Philadelphia, 1942, p. 460.
7. PROETZ, A. W. Some intimate studies of nasal function; their bearing on diagnosis and treatment. *Ann. Otol., Rhin. & Laryng.*, 1932, *41*, 125–140.
8. SIMON, E. Anatomy of the opening of the maxillary sinus. *Arch. Otolaryng.*, 1939, *29*, 640–649.
9. SIMON, E. Atmospheric pressures in nasal fossa, maxillary sinus and trachea. *Arch. Otolaryng*, 1944, *39*, 504–513.

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SOLITARY MYELOMA OF THE FRONTAL BONE*

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SOLITARY myeloma is a rare type of tumor, and when found in association with osteitis deformans the diagnostic problem becomes even more confusing because of the much more common combination of Paget's disease and sarcoma. The present case is reported because of the problem it posed in differential diagnosis.

In 1943, Esposito reported a case of solitary myeloma of the skull, stating that of the 46 cases he found in the literature only 5 were in the skull. His case made 6, and the present case makes seven.

Briefly, the problem presented to us was as follows:

A well nourished female, aged forty-two, a housewife active in her work, had been complaining of some indefinite headaches for a period of about four years. She had a roentgen examination of her skull shortly after the pains became a factor, at which time the presence of Paget's disease was demonstrated, but there was no defect in the calvarium. During the next three years she saw several doctors until finally she was sent into the hospital for an additional roentgen examination because a swelling had appeared in the left post frontal region which was slightly tender and quite hard. The roentgenogram obtained at this examination is shown in Figure 1.

This presented a real problem in differential diagnosis. Sarcoma would immediately be thought of because sarcoma is not infrequently found associated with Paget's disease, but it is indeed rare to find such an association in the skull. In fact, sarcoma of the skull, especially of the calvarium, is extremely rare, probably because of the membranous origin of this portion of the skull. When sarcoma does occur it is apt to follow sutures in much the same manner as does the sympathicoblastoma or neuroblastoma. Hence it seemed possible to eliminate sarcoma as a likely diagnosis. By the history it was not of traumatic origin, hence we could rule out a leptomeningeal or hematogenous cyst. The history also ruled out in large measure any possibility of its being due to an infectious cyst or eosinophilic granuloma.

The lesion obviously was not a metastasis because its outline was too distinct, and the patient was in relatively good health. A much more likely lesion and one much more difficult to rule out was an epidermoidoma. Such a tumor could duplicate the lesion seen, but the margins of the defect in question were not clearly defined around the entire area and the swelling was not typically fusiform. The diploë was not expanded so that the margin did not present a line of increased density as we so often find with the epidermoidomas.

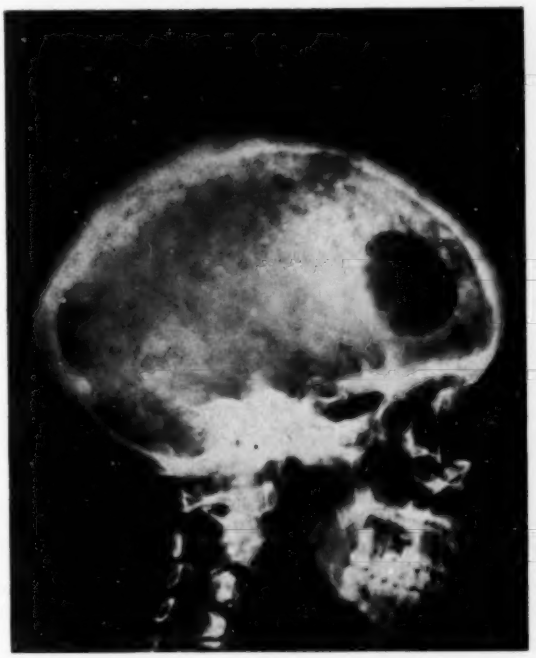

FIG. 1. Defect in frontal bone caused by solitary myeloma.

Thus it was possible to eliminate most of the probable diagnoses, and about the only remaining type of tumor which could produce such a bone defect would be a myeloma. Inasmuch as there was no evidence of more than one lesion, it was thought that we were dealing with a solitary type of this neoplasm, which was the

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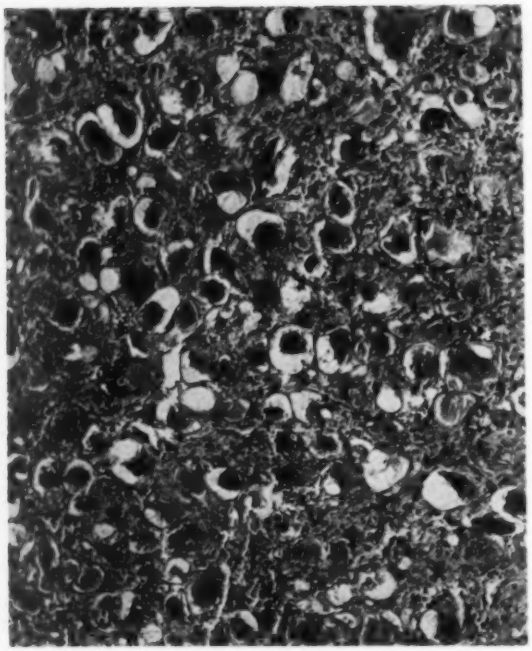

FIG. 2. Photomicrograph of biopsy specimen.

diagnosis offered as the most probable. But inasmuch as there was a possibility that the lesion might be an atypical epidermoidoma, and as the treatment for these two tumors is quite different, it was considered wise to obtain the aid of the surgical department for a biopsy study. A biopsy was done by Dr. H. A. Vier and the report of the pathologist, Dr. P. T. McIllroy, was as follows:

"The biopsy specimen removed from the temporal bone presents a pinkish white homogeneous cellular appearance throughout. It measures 2 cm. in length and 0.5 cm. in width. Microscopic examination showed the growth made up of large numbers of multinucleated cells supported by a stroma of spindle and oval shaped connective tissue cells which are lying in a small amount of collagen fibril. It resembles histopathologically the solitary tumor found in the epiphyseal end of long bones. The accompanying photomicrograph (Fig. 2) shows the relatively large numbers of myeloplaxes. The diagnosis was giant cell myeloma of the skull."

The patient's urine was examined for Bence-Jones bodies but none were found. It seems likely, however, that this albuminoid substance is produced by lesions in the red bone marrow and therefore would not be expected to exist in cases involving only the skull, and particularly when the lesion is only in the calvarium, because of its membranous origin.

Upon confirmation of the diagnosis by the pathologist, radiotherapy was decided upon as the treatment of choice, and the lesion was treated over a period of eight days during which time a total of 1,274 r was administered in divided doses using 200 kv., with filtration of 0.25 mm. Cu plus 1 mm. Al, through a single field over the tumor. The tumor mass gradually regressed until at the end of a month a depression instead of an elevation could be felt over the area. At this time another series of treatments was given, consisting of 1,554 r administered in divided doses over a period of twelve days, using the same factors as before. After the lapse of about a year, bone could be demonstrated filling in the defect and as might be expected the new bone was typically that of osteitis deformans. Paget's disease is now the patient's chief complaint because the pathological condition is not confined to the skull, and bone pain elsewhere is a factor.

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REFERENCES

1. CAPPELL, D. F., and MATHERS, R. P. Plasmacytoma of petrous temporal bone and base of skull. *J. Laryng. & Otol.*, 1935, *50*, 340–349.
2. CUTLER, M., BUSCHKE, F., and CANTRIL, S. T. Course of single myeloma of bone; report of 20 cases. *Surg., Gynec. & Obst.*, 1936, *62*, 918–932.
3. ESPOSITO, J. J. Case of solitary myeloma of skull. *Radiology*, 1943, *40*, 195–197.
4. GROSS, R. E., and VAUGHAN, W. W. Plasma cell myeloma. AM. J. ROENTGENOL. & RAD. THERAPY, 1938, *39*, 344–352.
5. PAUL, L. W., and POHLE, E. A. Solitary myeloma of bone. *Radiology*, 1940, *35*, 651–666.
6. STEWART, M. J., and TAYLOR, A. L. Observations on solitary plasmocytoma. *J. Path. & Bact.*, 1932, *35*, 541–547.
7. WILLIS, R. A. Solitary plasmocytoma of bone. *J. Path. & Bact.*, 1941, *53*, 77–85.

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DISSEMINATED CALCIFIED AND BONY NODULES IN THE LUNGS ASSOCIATED WITH MITRAL DISEASE*†

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THE roentgenographic examination of the lungs in long-standing cardiac disease may simulate, on occasion, hematogenous tuberculosis, silicosis or sarcoidosis. Indeed, in the literature the finding of disseminated calcified or ossified nodular densities has only rarely been included in discussions of pulmonary findings associated with chronic heart disease.[1,3,7,12,17] In 2 cases[10] calcified or ossified pulmonary nodules were found in association with mitral stenosis, but the relationship was not stressed specifically. Roesler[15] mentions and illustrates one instance and, following Virchow's terminology,[19] speaks of "multiple osteomata." Wells and Dunlap[20] recently published the postmortem findings in a case which unfortunately was not examined roentgenographically during life. These authors presented the pathological and histological features in great detail, summarizing the case reports in the literature and discussing extensively the possible etiology. No other mention of this association of lesions has been found in the English or American literature.

The first description correlating the roentgenographic and pathologic findings was given by Salinger[16] in 1932: a patient with long-standing mitral stenosis presented numerous nodular shadows of calcium density in both lower lungs along with the clinical and roentgenographic findings of mitral stenosis and insufficiency. Postmortem examination revealed them to be nodular bone formations in the lungs. Although such nodules had been observed prior to this report, their connection with mitral stenosis had not been discussed before. Since Salinger's description, several scattered case reports have appeared in the German and French literature.[2,8,9,11,21] All of the cases were associated with mitral stenosis.

The present report is an attempt to correlate the roentgenographic, pathologic and clinical findings in 8 cases. The significant details of the history, clinical, roentgenographic and pathological examinations are presented in tabular form. All of the 8 cases presented suffer from mitral stenosis and insufficiency and present nodular calcific shadows in both lung fields. In 4 cases, the lesion was discovered preceding the first episode of congestive heart failure. One case (Case VIII) has never had clinical congestive heart failure.

DISCUSSION

The pathogenesis of the pulmonary lesions is not clear. Since the majority of cases examined postmortem showed only bone formation, it is assumed that the transitional stages are short lived and occur in the early phases of the disease. The explanation offered by Gross,[8] and Gross and Müller,[9] and accepted by Wells and Dunlap[20] assumes:

1. Transudation of plasma and red blood cells into the alveolar spaces due to pulmonary vein congestion.
2. Disturbed resorption due to persistent pulmonary venous congestion and coexistent pulmonary lymphatic congestion.
3. Organization of the transudate by connective tissue.
4. Secondary calcification of these areas which is facilitated by the presence of hemosiderin.
5. Subsequent transformation into bony tissue through osteoblasts which form

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† Gratitude is extended to Dr. J. G. Sharnoff, pathologist, Lincoln Hospital for allowing the use of the postmortem material of Case v.
‡ Aided by a Grant from Dazian Foundation for Medical Research.

TABLE I

Case No.	Clinical Diagnosis	Name	Sex	Age	First Attack Rheumatic Fever	Recurrence of Rheumatic Fever	Episodes of Congestive Heart Failure and Clinical Course	Episodes of Congestive Heart Failure Preceding Discovery of Calcified Lesions	Roentgen Findings
I	Mitral stenosis and insufficiency; auricular fibrillation	S.S.	M	23	At age of 13 yr.	At age of 22 yr.	At age of 23; acute pulmonary edema. Discharged after one month of hospitalization where he received digitalis with marked improvement	None	The heart shows a marked prominence of middle segment of the left cardiac contour. Elevation of the right cardiac supracardiac junction. Double contour on right cardiac border: large left auricle. Hilar congestion bilaterally. Numerous calcified nodular shadows in both lower lung fields from pinpoint to pea size (see Fig. 1)
II	Mitral stenosis and insufficiency; giant left auricle; relative tricuspid insufficiency; auricular fibrillation; chronic congestive heart failure	L.N.	M	31	8 yr.	24 and 30 yr.	At age of 26, gradually progressing. Died at 31 of advanced congestive heart failure predominantly right sided. No postmortem	Pulmonary lesions were discovered only five years after onset of congestive heart failure. No previous roentgenograms available	The heart is greatly enlarged to the left and to the right and of triangular shape. A double contour is visible on the right cardiac border. The right auricle extends to the right anterior axillary line. The mitral valve is calcified. The left bronchus is almost horizontal. The hilar vascular shadows are very prominent. There are numerous calcified nodular shadows in both lower lung fields from pinpoint to pea size (over-penetrated and fast Potter-Bucky technique).
III	Mitral stenosis	R.J.	F	31	7 yr.	14, 24 and 31 yr.	First episode with onset of auricular fibrillation at 24. Chronic congestive heart failure since	None. Report of pulmonary roentgen findings during first episode of heart failure: "there are small calcified deposits throughout both lower lobes more or less symmetrical"	The heart is enlarged to the left and somewhat to the right. The left middle segment is prominent and elongated. A double contour is present on the right cardiac border. There are very numerous calcified nodular shadows present in both lower lung fields from pinpoint to pea size (Fig. 2 and 3).
IV	Mitral stenosis and insufficiency; pulmonary infarction; right-sided pleural effusion	S.K.	M	35	10 yr.	27 and 35 yr.	At 27; chronic congestive heart failure since	At 35 episode of massive right-sided pulmonary infarction with sanguineous right pleural effusion. Only roentgenograms of this admission available	The heart shows considerable prominence of the lower and upper arc of the left middle segment as seen in left auricular enlargement. An effusion occupies the lower posterior portion of the right pleural cavity. The visible pulmonary segments are moderately congested. Numerous calcified nodular shadows can be seen in the left lower lung field; mostly of lentil to pea size (right lower lung field obscured)

V	Mitral stenosis and insufficiency; angina pectoris	A.H.	M	29	Chorea at 7 yr.	Apparently none	At age of 29 leading to death; postmortem	None. First chest roentgenogram taken 6 yr. before onset of heart failure (for angina pectoris) showed lesions	The heart is moderately enlarged to the left with a considerable prominence of the left middle segment. The pulmonary vascular markings are slightly increased. Widely disseminated calcified nodular shadows are seen in both lung fields, most numerous in the lower portions. Histological examination showed these areas to consist of bony tissue (Fig. 4, 5, 6 and 7)
VI	Mitral stenosis and insufficiency	B.A.	M	45	? cardiac murmur discovered at age of 21		Onset of auricular fibrillation and congestive heart failure at 32 yr. Cerebral embolism 2 yr. later. Died of congestive heart failure. No postmortem	Chronic congestive heart failure for at least 10 yr. prior to discovery of pulmonary lesions	The heart is considerably enlarged to the left; the left middle segment is markedly prominent; slight enlargement to the right. The pulmonary artery branches are markedly prominent. There is a right pleural effusion. Numerous calcified nodular shadows in both lower lung fields
VII	Mitral stenosis	H.B.	M	35	Chorea and rheumatic fever at 11 yr. Cardiac murmurs discovered at 15 yr.	None	Increasing dyspnea for past 2½ yr. improving on digitalis. Recent episode of cough, pain in right chest and bloody expectoration; pulmonary infarction. Improved	2½ yr. of heart failure preceding discovery by roentgen examination of pulmonary nodular shadows	The heart is moderately enlarged to the left and right. The middle segment of the left cardiac contour is elongated and prominent. Both lower lung fields are moderately congested. The pulmonary artery branches show a considerable prominence. Numerous small calcified nodular shadows are present in both lower lung fields
VIII	Mitral stenosis and insufficiency	P.S.	F	31	? murmurs discovered at age of 18 yr.		Dyspnea on climbing stairs for past 4 years	No history or any finding of acute or chronic decompensation	The point of opposite pulsations is considerably lowered. Both arcs of the middle segment are prominent. A double contour is visible at the upper third of the right cardiac contour. Numerous calcified nodular shadows are visible in both lower lung fields, varying considerably in size

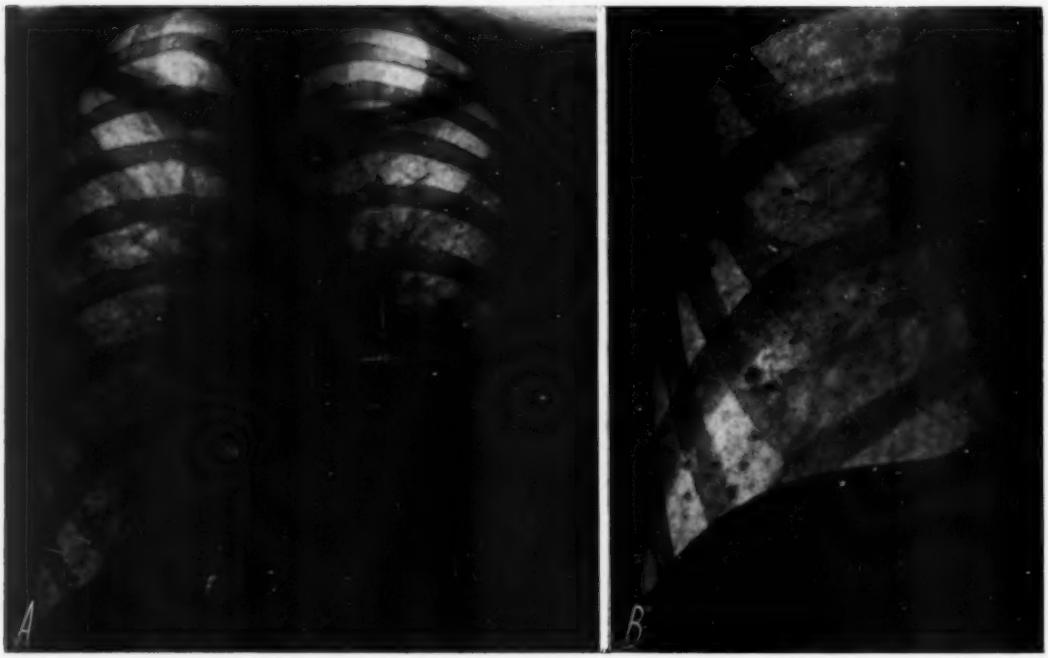

FIG. 1. Case 1. S. S., male, aged twenty-three. *A*, mitral configuration with hilar congestion. Note the basal distribution of the calcium dense lesions. *B*, enlarged section of right lower lung field.

haversian canals and bone marrow. This type of metaplasia occurs quite often in calcified tissues, particularly in tuberculous lesions (see Pollack[14] for detailed discussion).

Although these steps in development appear plausible, it is difficult to accept them entirely, since in many of the cases in the literature, as well as in 4 described here, the lesions were already established before any clinical congestive heart failure appeared. There is no evidence in any of the cases studied histopathologically that pulmonary arteritis or small pulmonary infarctions are precursors to such lesions, but the tissues which have been studied are an end-result where the original pulmonary changes occurred long before. Attention is called to the lack of knowledge of the pathogenesis of these nodules, with the suggestion that careful inspection of the lungs by the pathologist in cases of adolescent or pre-adolescent rheumatic fever may yield significant data. The clinical histories of the reported cases suggest strongly that the precursor to these lesions must appear early in rheumatic fever and probably in childhood. It would seem that factors other than or in addition to vascular congestion must be involved even though the predominant and sometimes exclusive distribution of the nodules at the bases favors congestive factors and their sequelae.

DIFFERENTIAL DIAGNOSTIC CONSIDERATIONS

The purpose of this report is to draw attention to the coexistence of disseminated calcified and bony lesions in the lungs and rheumatic mitral disease. The findings may be so insignificant as to be overlooked, especially when overshadowed by an enlarged heart, pleural effusions or pulmonary edema. On the other hand, the dissemination of these densities may be marked and they are apt to be considered "healed miliary tuberculosis." The occurrence of the latter is so infrequent, particularly in the calcified disseminated nodular phase, that some authors doubt its existence entirely.

Other possible etiological factors in the production of such a roentgenographic picture have been considered by various authors. These have included *Ascaris* infestation of the lungs, aspergillosis, and coccidiomycosis. However, no convincing evidence has been found that any of these conditions are responsible for disseminated calcified or ossified nodules.[1,3,4,5,6,7,12,17,18] For practical purposes the only important

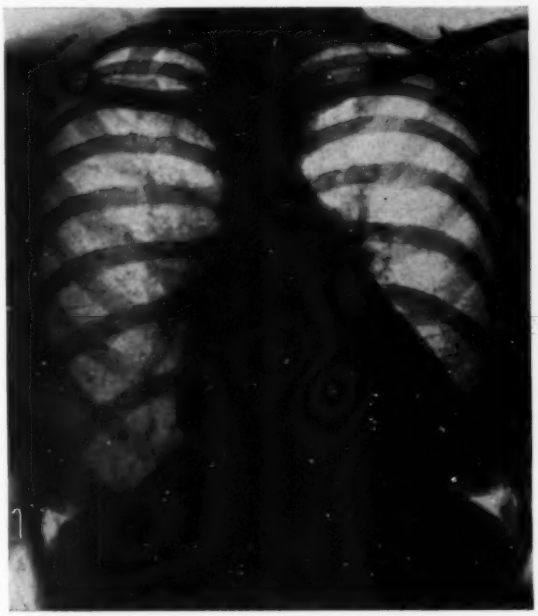

Fig. 2. Case III. R. I., female, aged thirty-one. Mitral configuration. Again the calcium dense lesions are seen to be distributed over both lower lung fields.

condition to be considered in the differential diagnosis is pulmonary tuberculosis. Although tuberculosis might be considered by some as an etiological possibility in these cases, the peculiar association with rheumatic mitral disease and its distribution characteristics would remain to be explained.

DISSEMINATED CALCIFIC AND OSSIFIED NODULES IN THE LUNG

Associated with Rheumatic Heart Disease

1. Predominantly basal bilateral distribution, occasionally extending upward toward but not involving the apices.

Fig. 3. Case III. Right lower lung field. Note the varying size of the lesions.

2. Associated with evidence of mitral stenosis and insufficiency. It is not necessary that the

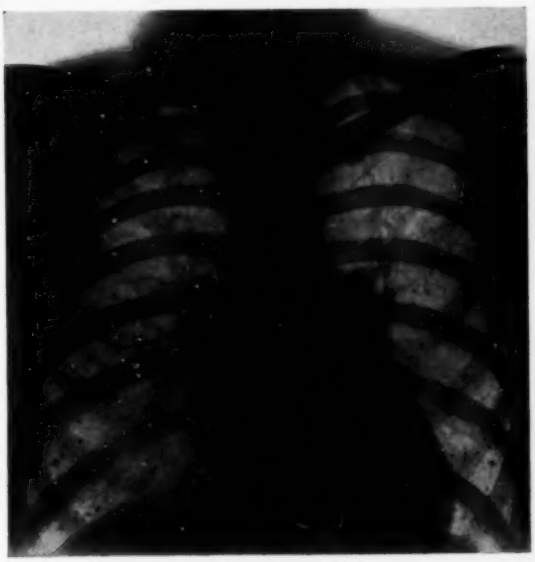

Fig. 4. Case V. A. H., male, aged twenty-nine. Predominant distributions of nodules in both lower lung fields.

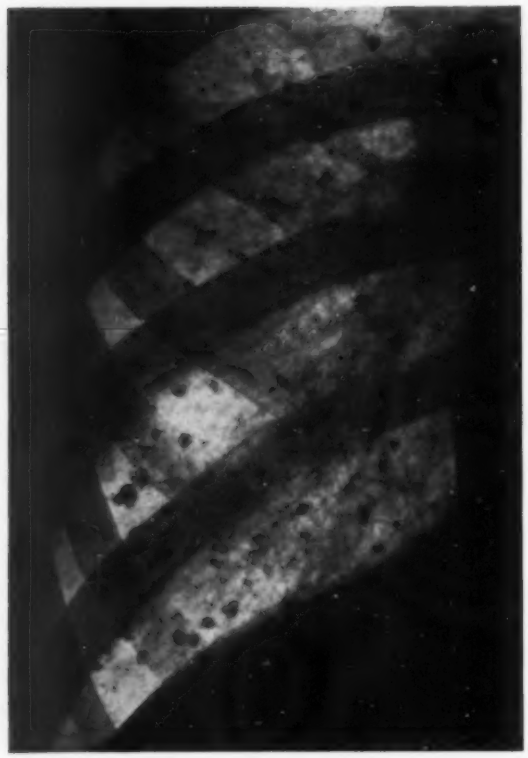

FIG. 5. Case v. Right lower lung field. Note the varying size and shape of nodules.

FIG. 6. Case v. Histopathologically the nodules consisted of bony tissue.

evidence of rheumatic valvular change be marked or striking. Evidence of pulmonary congestion, acute or chronic, past or present, need not be present.

3. Absence of other evidence of pulmonary tuberculosis, active or inactive.

Associated with Pulmonary Tuberculosis

1. Sporadic hematogenous dissemination of tuberculosis usually involves predominantly the upper lung fields.

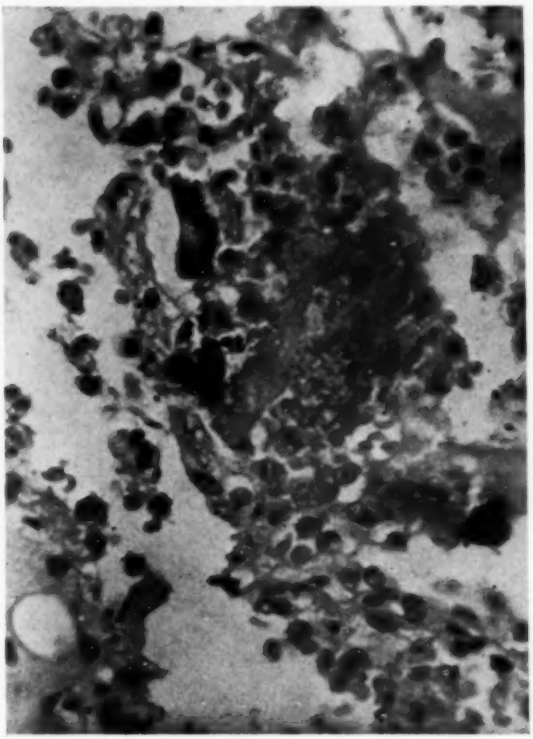

FIG. 7. Case v. In only one section could an area of calcification with central bone formation be seen. Only Munk's case[13] showed a similar picture.

2. Bronchogenic disseminations of tuberculosis, though frequently basal are associated with evidence of the source lesion in the upper lung fields and are more apt to be unilateral except when an intrabronchial hemorrhage has occurred.
3. Primary calcified or ossified tuberculous foci, though frequently basal, are rarely multiple.

4. Post-primary dissemination will usually be subject to the above hematogenous or bronchogenic distribution characteristics, and accompanied by other evidence of the parent lesion or lesions.
5. Healed calcified cases of chronic hematogenous dissemination are very rare, the nodular lesions when seen will usually vary more in size and will not be entirely, or predominantly, basal.

SUMMARY

Eight cases of mitral stenosis and insufficiency with disseminated nodular calcified deposits and bone formation in the lungs have been presented. The association of these findings and the gap in our knowledge of their pathogenesis have been reviewed. The essential triad of differential diagnostic features has been stressed.

REFERENCES

1. Austrian, C. R., and Brown, W. H. Miliary diseases of the lungs. *Am. Rev. Tuberc.*, 1942, *45*, 751–755.
2. Diehl, F., and Kuhlmann, F. Die Knochenbildungen in der Lunge mit besonderer Berücksichtigung der tuberösen Form. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 202–203.
3. Editorial. Calcified pulmonary lesions. Am. J. Roentgenol. & Rad. Therapy, 1943, *49*, 823–825.
4. Farrell, J. T., Jr. Incidence of roentgenographically observed calcified pulmonary foci and their significance; study of 1034 patients. *Am. Rev. Tuberc.*, 1928, *18*, 344–359.
5. Gass, R. S., and others. Tuberculosis studies in Tennessee; roentgenological evidence of tuberculous infection in relation to tuberculin sensitivity in school children. *Am. Rev. Tuberc.*, 1938, *38*, 441–447.
6. Gass, R. S., and others. Pulmonary calcification and tuberculin sensitivity among children in Williamson County, Tennessee. *Am. Rev. Tuberc.*, 1943, *47*, 379–387.
7. Geever, E. F. Miliary calcification of lung. Am. J. Roentgenol. & Rad. Therapy, 1943, *49*, 777–782.
8. Gross, A. Knotige Knochenbildung bei chronisch kardialen Stauungslungen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1938, *58*, 33–39.
9. Gross, A., and Müller, P. Röntgenologische Beobachtungen bei kardialen Stauungslungen, insbesondere bei chronischen Zuständen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1939, *59*, 428–439.
10. Hurst, A., Bassin, S., and Levine, I. Miliary densities associated with mitral stenosis. *Am. Rev. Tuberc.*, 1944, *49*, 276–285.
11. Janker. Knotige Knochenbildungen der Lungen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1936, *53*, 260–267.
12. King, D. S. Non-tuberculous miliary lesions of the lung. *Internat. Clin.*, 1938, *1*, 115–118.
13. Munk, E. Calcifications multiples disséminées dans les poumons dans la maladie mitrale. *J. de radiol. et d'électrol.*, 1939, *23*, 58–62.
14. Pollack, K. Ueber Knochenbildungen in der Lungen. *Virchow's Arch. f. path. Anat.*, 1901, *165*, 129.
15. Roesler, H. Clinical Roentgenology of the Cardiovascular System. Second edition. Charles C Thomas, Springfield, Ill., 1943.
16. Salinger, H. Die Knochenbildungen in der Lunge mit besonderer Berücksichtigung der tuberösen Form. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1932, *46*, 269–275.
17. Sayers, R. R., and Meriwether, F. V. Miliary lung disease due to unknown cause. Am. J. Roentgenol. & Rad. Therapy, 1932, *27*, 337–351.
18. Sweany, H. C. Observations on multiple tuberculous calcifications. *Am. Rev. Tuberc.*, 1935, *32*, 73–97.
19. Virchow, R. Kalk-Metastasen. *Virchow's Arch. f. path. Anat.*, 1855, *8*, 103.
20. Wells, H. G., and Dunlap, C. E. Disseminated ossification of lungs. *Arch. Path.*, 1943, *35*, 420–426.
21. Zdansky, E. Röntgendiagnostik des Herzens und der grossen Gefässe. J. Springer, Wien, 1939, pp. 299–300.

MALIGNANT GIANT CELL TUMOR OF THE LUNG*

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THE lung is a very common site of primary epithelial tumors but instances of sarcoma are infrequently encountered. The following case is reported for its unusual histopathological features.

REPORT OF CASE

A. W., a white male, aged forty-seven, was admitted for the second time on September 26, 1939. In 1932 there was a brief episode of polyarticular pain and swelling. On his first admission, August 27, 1935, he complained of precordial pain and dyspnea of six months' duration. The roentgenogram of the chest showed slight widening of the aortic arch and the lung fields were clear. He was discharged on September 7, 1935, with the diagnosis of hypertensive and arteriosclerotic heart disease. In July, 1939, the patient developed pains in the ankles, knees, elbows, wrists and fingers. He was treated at home and returned to work three weeks later. A few days before admission, he noted chills and palpitation. There were no respiratory symptoms or loss of weight.

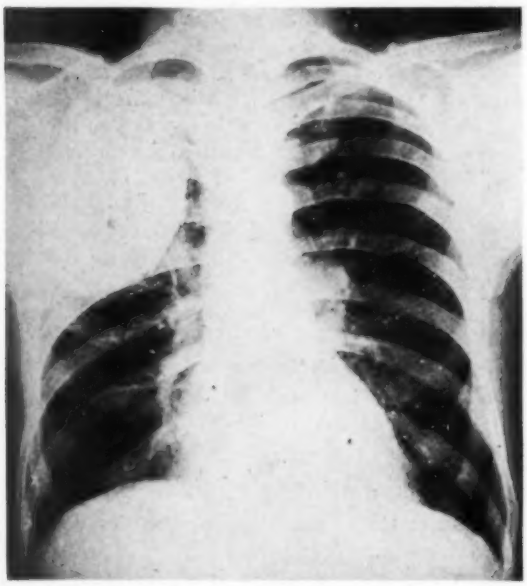

FIG. 1. Patient A. W. Roentgenogram of chest taken on October 7, 1939.

The patient was acutely ill with a temperature of 104.6° F., pulse 100 and respirations 24. There was dullness over the right upper lobe posteriorly with diminished breath sounds. The liver extended two fingerbreadths below the costal margin. There were swelling, tenderness, and limitation of motion of the ankles, knees, elbows and wrists and fingers, and clubbing of the fingers was marked. Except for a slight leukocytosis, the urine, blood chemistry, and blood count were within normal limits. The sputum was negative for tubercle bacilli. Roentgen studies revealed a periostitis of the clavicles, tibiae, fibulae and bones of the hands. Within the right upper lateral lung field was a spherical homogeneous density which extended from the apex to the third anterior rib (Fig. 1). Bronchoscopy demonstrated an intact bronchial mucosa. A diagnostic pneumothorax resulted in some downward displacement of the roentgen shadow. A small effusion subsequently formed and sterile serosanguineous fluid was aspirated. The patient ran an irregular type of fever throughout his hospital course. He developed cough with scanty expectoration and pain in the right chest. In the latter part of November, auricular fibrillation and pitting edema of both lower extremities appeared. He was given digitalis and diuretics with temporary improvement. The patient died suddenly on December 26, 1939.

Postmortem examination was done three hours after death. The right pleural cavity was entirely obliterated by diffuse dense fibrous adhesions. The left pleural cavity contained 2,000 cc. of clear straw-colored fluid and the pleural surfaces were smooth. The ribs and vertebrae were intact. The peribronchial lymph nodes were of average size and on section were gray with mottled black areas.

The right lung weighed 2,000 grams (Fig. 2). The upper and middle lobe fissures were partially obliterated and the middle lobe near the hilum was firmly bound to the adjacent upper lobe. The upper lobe was enlarged, firm and dark purple with black mottling. The upper and lateral surfaces were covered with thick fibrous tissue. The middle and lower lobes were small,

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hypocrepitant, flabby and had a dark purple surface with black mottling. On section, the upper lobe was replaced by a large spheroidal mass measuring 20 by 15 by 12 cm., which had a pearly white appearance with a soft, friable and dark red central portion. The periphery was limited by a rim of compressed lung, except over the posterior lateral aspect of the lobe where it was indistinguishable from the cover-

Fig. 2. Malignant variant of giant cell sarcoma of the lung.

ing fibrous tissue. Near the hilum this mass extended into the middle lobe. The cut surface of the middle and lower lobes was dark red. The left lung weighed 600 grams, and the surfaces were smooth and gray with fine black mottling. The consistency was hypocrepitant and on section the cut surfaces were deep red and exuded an excess amount of frothy, blood-tinged fluid. The bronchi of both lungs contained a frothy fluid and the mucosae were smooth and pink.

Microscopically, the parenchyma of the right upper lobe is compressed by a poorly circumscribed tumor composed of large fusiform cells (Fig. 3) arranged in a syncytium-like manner, the protoplasm of one cell blending into that of another. The cytoplasm is lightly acidophilic, finely granular, and contains occasional large clear vacuoles. The nuclei are large, irregularly oval and vesicular with prominent nucleoli. These cells vary markedly in size and shape (Fig. 4), are frequently seen in a state of mitoses and are occasionally seen as large cells with two elongated nuclei (Fig. 5). Diffusely scattered among these stromal cells are many large giant cells (Fig. 6) with abundant acidophilic, finely

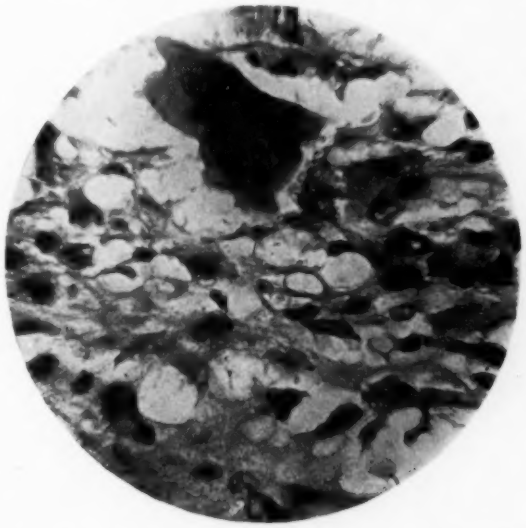

Fig. 3. Syncytium-like arrangement of vacuolated sarcoma cells with a multinucleated giant cell.

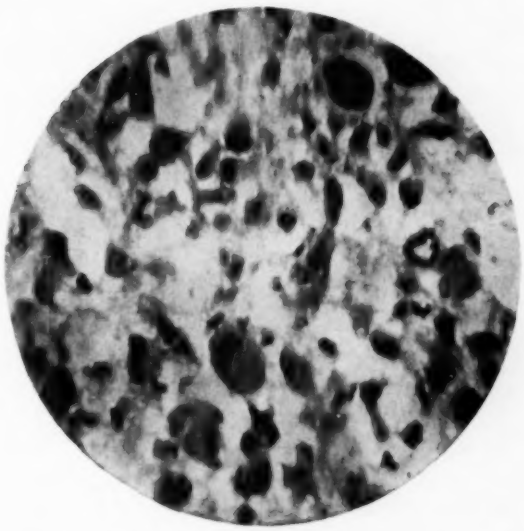

Fig. 4. Marked variation in the size and shape of cells with a hyperchromatism of the nuclei.

granular cytoplasm which has short processes and contains small vacuoles. The nuclei vary from 10 to 50 in number; they are round, vesicular, and have conspicuous nucleoli. Within the tumor are numerous thin-walled blood vessels. Within large areas of necrosis these vessels contain thrombi. Sections of a tracheo-

bronchial lymph node and rib are devoid of tumor.

The additional postmortem findings were tubular adenoma of the left kidney, myocardial fibrosis and hyperplasia of the bone marrow.

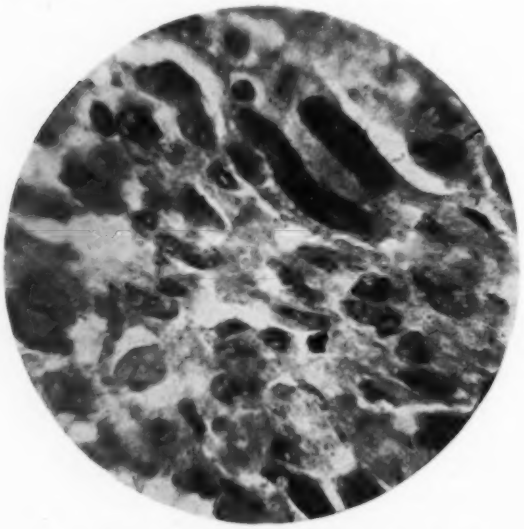

FIG. 5. Elongated giant spindle-shaped cells.

DISCUSSION AND CONCLUSIONS

It is difficult to feel certain that such a sarcoma, as has been presented, actually arose within the lung and was not merely a metastasis from an undisclosed minute skeletal tumor or direct extension from a primary intrathoracic neoplasm. However, this patient's entire osseous system was carefully roentgenographed before his death, and the only pathological change recorded was hypertrophic pulmonary osteoarthopathy. Postmortem examination of the mediastinal cavities, ribs, and vertebrae did not disclose any possible primary source. Furthermore, the tumor, *per se*, was a single mass limited to one lobe and separated from the thoracic cage by pleura or fibrous connective tissue.

The unusual feature of this neoplasm is its histopathological similarity to malignant giant cell tumor of bone. In these tumors, Stewart, Coley and Farrow[1] found many giant cells with few nuclei and often large nucleoli. Between the giant cells were large fusiform, syncytium-like cells with rather clear cytoplasm and large nucleoli. Atypical mitoses were common. Evidence of bone or cartilage was not found. In their 7 cases occurring in bone, no instance of pulmonary metastases was noted. Jaffe, Lichtenstein and Portis[2] mention 2 instances of malignant transformation of giant cell tumor with pulmonary metastases, but the one lung lesion described microscopically in the case reports did not possess a giant cell structure.

Jaffe, Lichtenstein and Portis consider giant cell tumors of bone to arise from undifferentiated marrow mesenchyme. It is possible that our giant cell tumor of the lung arose from pleural or interstitial pulmonary mesenchyme.

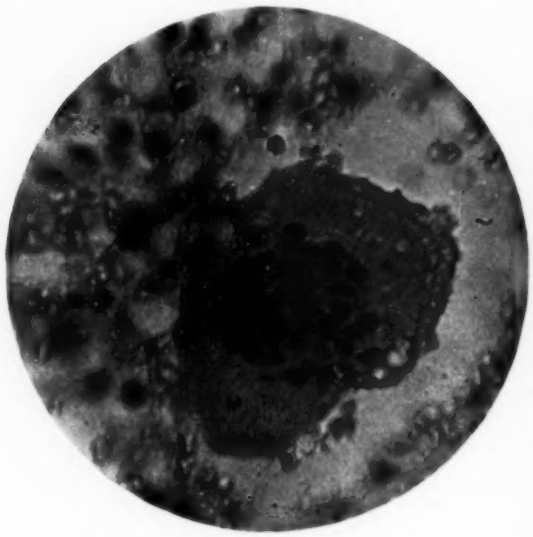

FIG. 6. High power field of a multinucleated giant cell.

REFERENCES

1. STEWART, F. W., COLEY, B. L., and FARROW, J. H. Malignant giant cell tumor of bone. *Am. J. Path.*, 1938, *14*, 515–536.
2. JAFFE, H. L., LICHTENSTEIN, L., and PORTIS, R. B. Giant cell tumor of bone. *Arch. Path.*, 1940, *30*, 993–1031.

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INTUSSUSCEPTION OF THE STOMACH

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THIS case is presented because a thorough search of the literature revealed no adequate illustration depicting direct intussusception of the stomach.

This condition may be defined as the invagination or indigitation of a portion of the full thickness of the stomach into the portion of the alimentary tract just distal. In retrograde or indirect intussusception, the lower full thickness segment is drawn up into the upper segment.

In contrast, prolapse of the gastric mucosa alone into the duodenum is not uncommon.

In 1913, Wade described the operative findings of a case in detail but had little to say about the roentgen diagnosis.

In 1922, Eusterman and Sentry reported this condition in a case operated on for gastric neoplasm with no roentgen findings.

In 1926, Eliason, Pendergrass and Wright, and since then many others, have reported on benign tumors of the stomach associated with prolapse of the gastric mucosa. These were not cases of intussusception.

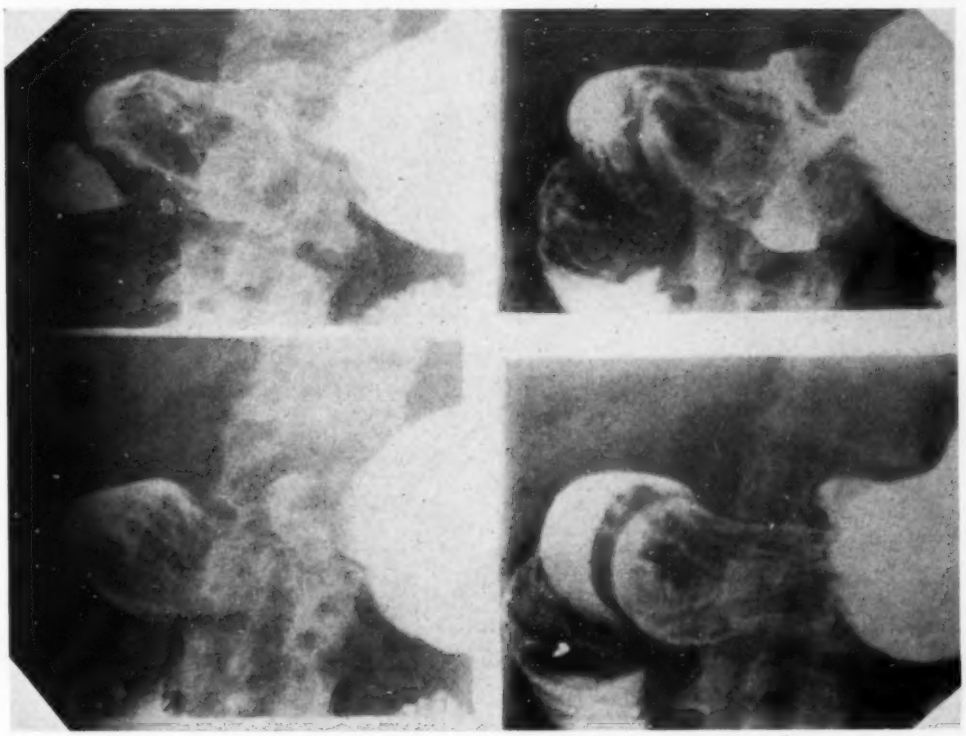

FIG. 1. Intussusception of stomach during attack of pain.

In 1933, Lönnerblad reported 2 cases of intussusception diagnosed roentgenographically.

The etiologic basis for simple prolapse is usually the presence of a mass, often a benign polyp, in the pylorus which prolapses through the sphincter causing traction on a portion of the gastric mucosa.

Theoretically, it is possible for such a mass to cause traction on the full thickness of the stomach offering a simple explana-

tion for intussusception in the presence of a pedunculated mass. There is, however, no adequate explanation in the absence of a mass except to explain it on the basis of some disturbance of the innervation, either spastic or paralytic.

The following case is an example of a spontaneous direct intussusception in the absence of any mass.

FIG. 2. Normal stomach and duodenum in the interval.

CASE REPORT

The patient, a white male, aged seventy-eight, was seized with an acute attack of continuous epigastric pain accompanied by nausea, vomiting, and hiccoughing. The epigastric region was tender but not rigid. There had been a similar two day episode six weeks previously.

The roentgen examination revealed:

1. That the distal half of the stomach was markedly narrowed, and the duodenum was markedly widened as far down as the lower part of the second portion.

2. That the widened duodenum acted as the intussuscipiens, the narrowed portion of the stomach having telescoped or invaginated into the lumen of the widened duodenum.

3. That the intussusceptum reached the distal end of the dilated duodenum.

4. That the folds of the gastric mucous membrane were compressed in a horizontal direction and were seen within the surrounding concentrically arranged dilated duodenal mucous membrane folds.

5. That the emptying time of the stomach was greatly increased.

6. That spontaneous reduction occurred, at which time the stomach and duodenum were normal.

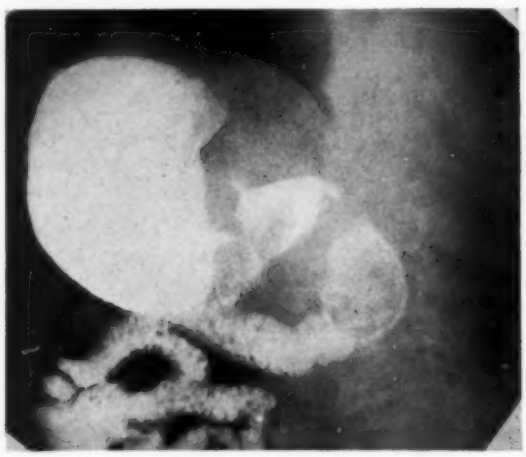

FIG. 3. Intussusception in a subsequent attack.

7. That subsequent roentgen examination during a later seizure again visualized the intussusception.

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REFERENCES

1. ELIASON, E. L., PENDERGRASS, E. P., and WRIGHT, V. W. M. Roentgen-ray diagnosis of pendunculated growths and gastric mucosa prolapsing through the pylorus; review of the literature. AM. J. ROENTGENOL. & RAD. THERAPY, 1926, *15*, 295–322.
2. EUSTERMAN, G. B., and SENTRY, E. G. Benign tumors of the stomach. *Surg., Gynec. & Obst.*, 1922, *34*, 5–15.
3. LÖNNERBLAD, L. Zwei Fälle von Mageninvagination. *Acta radiol.*, 1933, *14*, 82–94.
4. WADE, H. Intussusception of stomach and duodenum due to gastric polypus. *Surg., Gynec. & Obst.*, 1913, *17*, 184–190.

MILITARY PHOTOROENTGEN TECHNIQUE EMPLOYING OPTIMUM KILOVOLT (PEAK) PRINCIPLES*

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THE practice of 4 by 5 inch photoroentgenography has encountered many difficulties during the period of its employment by the Armed Forces. The sudden and early demand for photoroentgenograms of the chests of inductees created a measure of consternation, for large volumes of work were precipitately thrust upon induction stations without an adequate opportunity to train personnel nor to crystallize a rational photoroentgenographic procedure. As personnel began to become experienced, a degree of standardization developed with some improvement in results, but it was largely only in direct proportion to the ingenuity and conscientiousness of personnel operating individual photoroentgen units.

An outstanding fault with photoroentgen techniques was the toll exacted in the form of damaged roentgen-ray tubes and wasted film. Obviously, the diagnostic value of the photoroentgenogram is in direct ratio to its technical quality; yet, the careless and often thoughtless attention given to its exposure and processing contributed greatly toward diagnostic inaccuracies.

Photoroentgenography is not entirely a roentgenographic procedure for although the fluorescent image of the chest is caused by the action of the roentgen rays, the *recording* of the image is distinctly a photographic process. The processing procedure necessarily must depart in some measure from the conventional one employed for roentgenograms since the film emulsion is primarily a photographic one. Lack of appreciation of these facts has been the reason for most failures to produce satisfactory results.

As evidenced by a survey of many induction station laboratories, a fixed standard of technique was not habitually used. Exposures were based upon a variable kilovoltage-thickness of part technique and the variety of factors employed demonstrated lack of a systematized procedure which was in keeping with the poor results obtained. Considerable latitude in choice of factors was widely evidenced which was to be expected since no unanimity of opinion had been evinced that would lead to the production of photoroentgenograms of uniformly good quality.

A prevalent fault was the use of kilovoltages much too low to effect complete penetration of the chests of the average and large subjects; this resulted in loss of detail, particularly in the peripheral portions of the chest. In an attempt to produce a satisfactory image under these circumstances, higher and higher milliampere-second values were employed coincident with excessive tube damage, without obtaining satisfactory results. Also, it was impossible to secure an image of satisfactory density when film development varied greatly and little or no control over the temperature was exercised. The proper type and quality of roentgen film developer employed was seldom considered. For example, the use of inadequate kilovoltage often necessitated the limiting of photoroentgenographic examination to those chests measuring less than 24–25 cm.; larger chests required roentgenographic examination on 14 by 17 inch roentgen film. Obviously, a limitation of this kind incurred the necessity for two examining procedures instead of one, as was originally intended.

Realizing the shortcomings of the technical factors normally employed in chest photoroentgenography, especially the kilo-

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voltage, some personnel began to employ higher kilovoltages with some measure of success, although the time of development of the roentgenogram was still *too short* to permit a proper image density to appear on the film. A disadvantage recognized, but tolerated, was the presence of abundant secondary radiation fog on the photoroentgenogram. This was corrected to some extent in some laboratories by the use of a grid, although the kilovoltages applied when employing this device were still not sufficiently high to produce a satisfactory image. On the other hand, applied milliampere-second values often were increased to compensate unwittingly for lack of full development. The development times were still too short to permit adequate densities to be built up. The high milliampere-second values *seemed* necessary to compensate for the loss in density; yet the kilovoltages employed were too low to produce a satisfactory image because of incomplete penetration of the chest. All these factors necessitated adjustment if results were to be diagnostically acceptable. The foregoing was the status of photoroentgenography when it was decided to apply the optimum kilovoltage technique theory in an effort to obtain more desirable results.

In the summer and fall of 1943, with the able technical assistance of Captain Philip McMahan, SnC, and the Technical Staff of the Armed Forces Induction Station, Baltimore, Maryland, experimental exposure data were secured which was based on the optimum kilovoltage theory of technique. The experimental techniques developed were used by selected photoroentgen laboratories in order to procure representative photoroentgenograms as made with varying degrees of technical aptitude. Based on the results obtained, a standardized technique was evolved that was simple to apply, reduced potential tube damage to a minimum and provided photoroentgenograms of limited variability as regards image densities. It was not deemed wise to effect total density uniformity in comparable areas, for the small differences in density, caused by variations in tissue radiopacity, have pathological, physiological or anatomical significance and are, therefore, of diagnostic value.

Based on this preliminary work, a standardized exposure technique and processing procedure were employed in making an experimental survey of a representative group of inductees passing through an induction station. The quality of the photoroentgenograms secured in 1,111 cases was in keeping with the prior excellent experimental results obtained.

EXPOSURE TECHNIQUE

Briefly, the optimum kilovoltage theory of technique[1] is based on the premise that for every roentgenographic projection, when employing a standard mechanical and electrical setup, there is an *optimum* kilovoltage that will fully penetrate a given part with the production of a minimum of secondary radiation fog. Its use depends upon the classification of all body parts into three groups for purposes of facilitating the use of time factors in convenient multiples; and, *a standardized processing procedure*. For its application to photoroentgenography, a stationary grid is necessary.

Apparatus. A generator capable of delivering 100 kv. (peak) at 200 ma. should be employed for this technique. A stationary anode roentgen tube with a focal spot of 5.2 mm. is used, although a rotating anode tube may be used if desired. A blower attached to the tube is advisable although it is not entirely necessary for the heat generated by the sequence of exposures recommended is well within the safe heat capacity of most tubes.

A synchronous timer capable of providing exposures in tenths of seconds is necessary. Timers should be checked at frequent intervals for accuracy by spinning top tests to insure uniformity of exposure.

Some photoroentgen laboratories are

[1] Fuchs, A. W., Optimum kilovoltage technique in military roentgenography. AM. J. ROENTGENOL. & RAD. THERAPY, 1943, *50*, 358-365.

equipped with apparatus possessing a capacity of 85 kv. (peak) at 200 ma. Such generators may be satisfactorily altered by the manufacturer to deliver 150 ma. at 100 kv. (peak) by the addition of an auxiliary piece of equipment.

Milliamperage. It is unwise to operate present army photoroentgen apparatus at its capacity of 200 ma. for roentgen tube damage when employing stationary anode tubes is excessive under such circumstances. Operation at capacity or greater results in destroyed tubes after as low as 2,000 exposures and as high as 25,000 exposures. This life span is not considered unusual when using 200 ma. It was found, however, that when 150 ma. was employed, an immediate economy in tubes resulted; their life was extended in many instances to over 110,000 exposures. For this reason, a milliamperage of 150 was established as an invariable standard.

Damage to tubes is largely caused by milliamperage and *not* kilovoltage. Damage is related to the heat developed per unit area of focal spot and the rate at which it is applied. This must be common knowledge, yet the objective has been to use high milliamperages and lower and lower kilovoltages. Most damage to tubes is caused by overloaded focal spots wherein melting and cracking of the bombarded area results; a *single* overcapacity exposure is sufficient to irreparably damage a tube. Such damage cannot be attributed *per se* to general overheating or thermal overload because the quantity of copper in the anode of most tubes usually is adequate to dissipate the heat generated under normal working conditions. The increase in *roentgenographic efficiency* produced by the use of increased kilovoltage is obtained with a proportionately smaller amount of heat because of the use of a lower milliamperage. When the tube is operated below its rated capacity, damage to the focal spot is relatively nil even though high kilovoltage is employed.

Kilovoltage. The use of 100 kilovolts as a constant in chest photoroentgenography may seem radical at first glance. However, certain desirable overall characteristics of the photoroentgen image must be considered. A maximum of image detail is procured only when the chest is fully penetrated. Since the penetration is controlled by the kilovoltage, 100 kv. (peak) was selected to penetrate any human chest. Obviously, such high kilovoltage will produce an abundance of secondary radiation. This is controlled or largely eliminated by the use of the stationary grid. Because of the reduction in the size of the image to one accommodated by the 4 by 5 inch film, grid lines are not normally visible.

The high kilovoltage provides *long scale* contrast so that all detail is visible yet the density is never excessive; the detail is visualized by means of a great number of small differences in density. This kilovoltage also provides such extreme exposure latitude that overexposure is impossible within the exposure limits cited in the technique chart to follow. The latitude also provides transparent images irrespective of the chest thickness; no areas of over- or under-exposure on the same image are visible. Silver is deposited in the greater portion of the chest image.

Secondary Radiation Fog. It was demonstrated by Sir Gabriel Stokes in 1852 that radiation striking substances capable of fluorescence caused visible light to be produced of a longer wavelength than the inciting radiation. For example, ultraviolet radiation, which is not visible, striking willimite crystals will cause this substance to emit a yellow-green fluorescent light. Since this light is within the visible spectrum, its wavelength is obviously longer than that of the invisible, shorter wavelength ultraviolet radiation.

A comparable phenomenon also occurs when short wavelength r-radiation strikes an object such as human tissue. The tissue will emit secondary *r*-radiation with a longer wavelength than the inciting roentgen rays. Since the kilovoltage applied to the roentgen tube determines in large measure the wavelength of the emitted primary beam, the relative amount of secondary

radiation reaching a film may be roughly forecast.

The influence of kilovoltage upon production of secondary radiation fog on the roentgenogram is not generally understood. Roentgenograms made with low kilovoltage are usually recognized because of the relative *absence* of secondary radiation fog and by the *short* scale of its contrast. The primary beam of long wavelength roentgen rays produced with low kilovoltage incites secondary radiation within the part they penetrate. Since the wavelength of this radiation is longer than that of the primary beam, most of these rays are absorbed by the tissues and few ever reach the film emulsion.

The shorter wavelength secondary radiation produced by the higher kilovoltages have appreciably more penetrating power and are not all absorbed by the tissues which generate them. Many reach the film and if the kilovoltage is sufficiently great, then the roentgenogram shows unmistakable evidence of secondary radiation fog. This may be illustrated by making roentgenograms of the pelvis with and without a grid. The fog in the latter roentgenogram may be easily seen when compared with the former.

Agents that produce *supplemental* deposits of silver on the film, such as secondary radiation, affect the overall image density. Secondary radiation fog is roentgenographically unwelcome and unwanted; it must be eliminated or reduced to a minimum by every known means such as is provided by the use of grids, cones, etc. Secondary radiation is unfocussed, aberrant and is rampant from every direction. Because of its unfocussed nature and its wide source, it produces a density which is *supplemental* to that produced by the primary beam. The quantity of secondary radiation is dependent upon the applied wavelength of the roentgen rays which is governed by the kilovoltage used.

The exposure effect of secondary radiation should not be considered when formulating exposures for the primary beam. This mistake is commonly made by technicians when kilovoltages instead of milliampere-seconds are changed with a view toward controlling or adjusting roentgenographic *density*. But, decreasing or increasing the kilovoltage does have a noticeable effect upon the amount of secondary radiation fog generated.

Secondary radiation fog may be likened to an observer viewing an object through a window pane. If the pane is dirty, the object seems indistinct. However, if the pane is cleaned, the object becomes clearly and distinctly visualized. Cleaning the pane is analogous to the use of devices such as cones and grids that tend to eliminate or reduce the amount of secondary radiation reaching the film and thereby clearing the roentgenogram of objectionable secondary radiation fog.

Tube Position. The long axis of the roentgen tube should be vertical in photoroentgenography and the cathode end of the tube should be uppermost. This makes it possible to take advantage of the "heel effect" of the anode in balancing roentgenographic densities. In this position, the greatest quantity of roentgen rays is directed toward the upper thorax where the greatest tissue density usually exists. Also, better dissipation of heat from the tube is effected for the oil heated by the anode rises, causing more efficient circulation.

The vertically placed tube must be centered properly for the relatively short standardized anode-screen distance of 36 inches may cause cutoff of the image when stereoscopic exposures are made. The tube should be centered, then the tube moved to the No. 1 stereoscopic position; after the first exposure is made, the tube is shifted to the No. 2 stereoscopic position. The No. 1 stereo-shift tube position should not be employed for centering. Furthermore, a total stereo-shift of 3 inches is adequate.

Exposure. All adult chests are classified in three groups—first, second, and third. The first group requires 0.2 sec. exposure; the second, 0.3 sec. exposure; and, the third, 0.4 sec. exposure. A fourth group requires

14 by 17 inch roentgenography. Since the percentage of these cases is very small, there is no reason to cause possible overheating of the focal spot in an attempt to make photoroentgenograms employing an exposure greater than 0.4 sec.

Rate of Operation. The rate of operation should be one stereoscopic pair per minute. This rate may *appear* to be slow, but if the patient is properly posed, and instructed as to respiration, the amount of time allotted will not be found too great in many instances. There is sometimes a tendency among personnel, as a matter of competition, to see how many cases can be handled in a given time. This leads to careless posing of the patient and does not permit temporary cessation of respiration.

Operation should take place for 50 minutes with 10 minutes rest per hour. Based on an eight hour day, 400 cases can easily be examined. The objective should be to maintain a steady rate of patient flow which helps to minimize personnel fatigue, assures superior technical results, and avoids excessive heating of the tube.

TABLE I

PHOTOROENTGEN TECHNIQUE OF CHEST

PROJECTION	POSTEROANTERIOR
PREPARATION OF PATIENT	Remove clothing and radiopaque material from area; if female, drape with cotton or paper cape.
LOCALIZATION POINT	Point over 6th thoracic vertebra placed opposite center of camera front.
POSTURE	Patient erect; toes placed on line 6″ anterior to face of camera; anterior aspect of thorax against front of camera so that 6th thoracic vertebra is opposite center of front of camera; chin extended and rests on chin-rest; hands on hips with thumbs directed anteriorly until shoulders touch face of camera. Median plane is coincident with long center axis of camera face.
RESPIRATION	Respiration suspended on *full* inspiration. If respiration is not carefully controlled, underexposure or blurring of image is apt to occur or there is insufficient pulmonary aeration.
TUBE ALIGNMENT	Long axis of tube is coincident with median plane (vertical). Cathode portion of roentgen-ray beam directed *cephalad* when pectoral girdle is well developed; *caudad*, when overdevelopment of the lower thorax or pendulous breasts are present.
PROJECTION CENTRAL RAY	Central ray projected in median plane perpendicularly to center of camera face through 6th thoracic vertebra.
STEREOROENTGENOGRAPHY	Stereo. No. 1: 1½″ shift, cephalad from centering point; stereo. No. 2: 1½″ shift, caudad from centering point.

PHOTOROENTGENOGRAPHIC FACTORS

CONSTANT FACTORS		VARIABLE FACTORS	
		Thickness	Time
Kv. (peak)	100	17–24 cm.	0.2 sec.
Ma.	150	25–27 cm.	0.3 sec.
Distance	36″	28–32 cm.	0.4 sec.
Stationary grid		33–	Use 14″×17″ roentgenography

Positioning. Positioning of the chest before the photoroentgen camera is important so that comparable anatomical areas are projected on the film. Rotation of the patient's trunk should be avoided. Respiration should be carefully controlled. Be sure you do not "rattle" the patient when giving him instructions. Details of posing, etc., are contained in Table 1.

ANALYSIS OF TECHNIQUE

For the convenience of photoroentgen

exposures, all chests are divided into three primary groups, since all technical factors except time are constant. The first group includes those chests measuring 17–24 cm.; the second comprises the 25–27 cm. group; and the third, 28–32 cm. In some cases a fourth group would consist of chests 33 cm. and greater in thickness which should require 14 by 17 inch roentgenography in the interest of tube conservation.

chests which were photoroentgenographed is charted in Table II.

Note that in Table II the first group is the largest and 0.2 sec. stereoscopic exposures were employed for 67.3 per cent of the cases; in the second group, 0.3 sec. exposures were employed for approximately 30.5 per cent of the cases, and in the third group, only 2.2 per cent required 0.4 sec. exposures. As a precautionary measure, a

TABLE II

Thickness Group	Posteranterior Thickness cm.	Number Chests Examined	Percentage of Each Thickness	Group Percentage of Total	Exposure
First	18	2	0.2	67.3	0.2 sec.
	19	11	1.0		
	20	20	1.8		
	21	88	7.9		
	22	177	15.9		
	23	227	20.4		
	24	223	20.1		
Second	25	169	15.2	30.5	0.3 sec.
	26	118	10.6		
	27	52	4.7		
Third	28	20	1.8	2.2	0.4 sec.
	29	3	0.3		
	30	0	0.0		
	31	1	0.1		
Total		1111	100.0	100.0	

An analysis of each of the first three groups in an experimental survey of 1,111 cases showed that all images were transparent and the densities within the areas of the great vessels and heart were comparable. The lateral borders of the bony thorax were, in most instances, clearly defined due to the complete penetration of the chest and the *long scale* of contrast provided by the high kilovoltage. All photoroentgenograms were examined by roentgenologists and were declared to be diagnostic.

A typical sampling of the results to be obtained employing this technique may be cited as an example. No photoroentgenogram was discarded because of technical fault. The statistical analysis of 1,111 three minute interval was permitted to elapse between each pair of 0.4 sec. stereoscopic exposures.

One exception to the above standardized technique should be made. Certain chests in the first and second groups were found to be wide and the posteroanterior thickness from a roentgen-ray absorption standpoint was greater than the group in which they were placed according to actual measurement. Photoroentgenographic images of wide chests are often cut off at the edges of films. These chests are usually shallow in posteroanterior thickness, the average proportionate relationship between flesh, bone and air-bearing tissue is upset and less air-bearing tissue is present. This condition re-

sults in slight peripheral underexposure of the film if the normal exposure is given. Wide chests, therefore, require an additional 0.1 sec. exposure plus the exposure time assigned to the group. It was also found that any photoroentgenogram which showed insufficient density in the first and second groups, although perfectly diagnostic, could be given a more desirable density on a retake by repeating the exposure plus 0.1 sec. Arbitrarily, the technician should increase the exposure in all cases of wide chests. In any case where the exposure yields a photoroentgenogram of slightly less than desirable density, the exposure should be increased by 0.1 sec. Maximum exposure in any case should never exceed 0.4 sec. in the interest of tube conservation.

The fourth group comprises chests 33 cm. and greater in thickness and should require the use of 14 by 17 inch roentgenography. The percentage of such cases is considerably less than 1 per cent and photoroentgenography is not justified from the standpoint of tube conservation. Photoroentgenography can be employed if found necessary, simply by increasing the time of exposure in excess of 0.4 sec., although it is not recommended with the tubes now available.

Anteroposterior Views. The relatively short anode-screen distance of 36 inches may at times cause the image of structures in the posterior portion of the thorax to be somewhat diffused in the posteroanterior view because of the long part-screen distance. In such cases, a stereoscopic anteroposterior view is of value. These views may be made simply by employing the same exposure factors used for the posteroanterior view plus 0.1 sec. exposure added to the basic time applied in the thickness group to which the case belongs. In other words, if a posteroanterior view of a 23 cm. chest is made employing 0.2 sec. exposure, the anteroposterior view of the same chest would require 0.3 sec. exposure.

TABLE III

TECHNICAL FACTORS FOR 14 BY 17 INCH CHEST ROENTGENOGRAPHY

Optimum kv. (peak).....80 Screens.....medium speed
Distance.....72" Development.....3 min. at 68° F. in *Kodalk* developer

Patient Class	Thickness Range, cm.	Ma.	Time sec.	Ma-sec.	Ma.	Time sec.	Ma-sec.	Ma.	Time sec.	Ma-sec.
Small	–19	30	1/10	3	50 100	1/15 1/30	3⅓ 3⅓	75 150	1/20 1/40	3.75 3.75
Average	20–27	30	2/10	6	100	1/15	6⅔	150	1/20	7.5
Large	28–	30	4/10	12	100	2/15	13⅓	150	1/10	15.0

14 by 17 inch Roentgenography. When 14 by 17 inch roentgenography is required, the following technical factors based on the optimum kilovoltage technique should be employed. Since the conditions of roentgenography of the chest are quite different from those of photoroentgenography, the thickness groups and kilovoltage employed must be changed as well as the time of film development. The posture assumed by the patient and arrangement of apparatus is approximately as described in the technique summary for posteroanterior photoroentgenography. The following technical factors (Table III) will provide images of consistently comparable densities. Exposure times are such that either synchronous or impulse timers may be employed; a selection of milliamperages will permit the employment of various types of apparatus.

PROCESSING PROCEDURE

Photoroentgenography entails the use of expensive apparatus. Irrespective of the care with which exposure factors are chosen or the patient posed and respiration controlled, the diagnostic quality of the photoroentgenogram secured is dependent upon the manner in which it is *processed*.

It must be realized that photoroentgenograms do not serve a transient purpose. They constitute records which are of extreme value to the Government or other agency, not only at the time they are made, but also years hence. It is urged that a standardized processing procedure be employed so that the basic objectives of photoroentgenography may be served now, as well as in the future.

Film (4 by 10 inch) employed for photoroentgenography is single coated, and the emulsion is most sensitive to the blue-violet light emitted by the fluoroscopic screen mounted in the photoroentgen camera. The photographic characteristics of the film are such that longer development must be employed than that normally given to roentgen film if a satisfactory image is to be secured.

The purpose of exposure is to sensitize the emulsion so that upon development the silver bromide will be capable of change to black metallic silver. The longer the period of development—up to a certain point—the more silver is deposited. Since the black metallic silver constitutes what is known as the image-density, there must be an adequate concentration of silver to obtain a substantial image of the *whole* chest. It is therefore necessary to develop the film in conformity with a standardized procedure in order to obtain the maximum density with freedom from fog. Unless the technician realizes these facts, there is no point in making the exposure for the results will not be worth the effort involved.

TABLE IV

Exhaustion Period	Time of Development	Number of Films (4″×10″) Developed in Tanks of Varying Capacity			
	68° F.	6 gal.	10 gal.	15 gal.	20 gal.
A	8 min.	637	1125	1767	2468
B	9 min.	292	518	809	1130
C	10 min.	214	375	589	821

One 14″×17″ film is equivalent in area to six 4″×10″ films.

A *standardized time-temperature* method of development must be employed if the photoroentgenograms are to possess uniform quality. Variation in time of development produces variations in image-density which influence the customary diagnostic appearance of the photoroentgenograms. When the processing procedure is essentially a constant and the exposure technique is standardized, variations in density may then be attributed to anatomical or pathological peculiarities of tissue.

Development. Photoroentgen film requires eight minutes' development at a temperature of 68° F. in fresh Kodalk x-ray developer. To insure complete development of the film to a standard density, the rate of exhaustion of the developer must be noted. By recording the number of films passed through the solution, compensation for the decrease in developer action must be made by changing the development time.

The time of development and the number of 4 by 10 inch films to be processed for given periods of exhaustion in given

quantities of solution are listed in Table IV. At the end of the "C" period, the developer is to be discarded and new solution placed in the tank. The fixing bath is also to be changed at the same time.

When the temperature of the solution changes, the development time must also change in order to maintain a standard density. The following time-temperature table should be employed to effect the proper change (Table V):

TABLE V

Temperature	Exhaustion Period Minutes		
	A	B	C
64° F.	9½	10½	12
66° F.	8½	9½	11
68° F.	8	9	10
70° F.	7½	8½	9
72° F.	6½	7½	8

Fixation. The purposes of the fixation of the photoroentgenograms are (1) to remove the unexposed silver bromide crystals from the film, thereby clearing it, and (2), to thoroughly harden the emulsion to facilitate drying.

Hardening of the film is dependent upon the use of a reasonably active fixing bath. If exhausted fixing baths are used, hardening of the film is diminished or entirely eliminated and the emulsion will remain swollen with solution. Melting of the emulsion may occur in the wash water or a prolonged drying time results.

To insure procurement of well hardened and shrunken emulsions, the quantity of fixing bath should be equal to 1½ times, or twice that of the developer. And, each time the developer is changed, the fixing bath should be changed. This procedure will make possible fast drying of films and eliminate many other troubles that are encountered with hot weather film processing.

Drying. Adequate film drying facilities are usually available in most laboratories, but film drying frequently is a problem that is still not given sufficient consideration. If the films are placed in the dryer with swollen emulsions, they will not dry rapidly, particularly when the atmospheric humidity of the room is high. Delayed drying is often attributable to recirculation of moisture laden air in the darkroom, the relative humidity being higher than that of the outside atmosphere. When emulsions are adequately hardened, the drying rate is fairly rapid; whereas if the humidity is high, the drying rate is unduly prolonged. Elimination of moisture laden air may be obtained by venting all film dryers to the outside.

When exposed films are placed in developing hangers, they should not be stacked directly under the safelight unless they are shielded. Exposed films are always more sensitive to exposure to the light from safelights than are unexposed films.

CONCLUSIONS

It has been proved that the photoroentgen technique as described has been found, in the many laboratories employing it, to be economical in time, use of materials and apparatus, and strain on the part of operating personnel. Its simplicity of operation and the high quality of results has served to promote greater diagnostic accuracy.

Where large numbers of individuals are to be surveyed, total reliance upon the judgment of operating personnel for exposure estimation is open to considerable error. The use of preformulated or standardized factors, as described in this paper, will assure a greater percentage of successful results than any other method now being used.

It will aid the technician to remember that in the optimum kilovoltage technique, the kilovoltage applied regulates the scale of contrast, production of secondary radiation and subject penetration; the milliampere-seconds control image-density.

The experienced technician soon learns to evaluate the patient quickly, mentally placing him in the required exposure group without the necessity for measurement. Small errors in estimating thickness have no significance for the kilovoltage employed will always penetrate the chest. The exposure determines the image-density.

The Morgan automatic exposure timer, employed with the optimum kilovoltage technique described, has made possible almost total uniformity in the film-densities obtained. This timer tends, however, to produce approximately the same image-density on each film. If the roentgenologist is willing to waive the small differences in density that have diagnostic significance from an anatomical, physiological, or pathological standpoint, then this timer will operate to produce density uniformity. The timer obviates measuring the patient.

If one were to prognosticate the future of photoroentgenography, developments will undoubtedly proceed along the lines of improvement in apparatus. Automatic cameras employing roll film, perhaps 2½ inches or 70 mm. in width, and automatic processing will do much to solve present day difficulties. The increase in speed of lens and fluorescent screen seems to be the necessity at the moment. The greater speed of lens and screen will make possible the use of smaller focal spot tubes and greater anode-screen distances.

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ROENTGEN THERAPY FOR ACUTE ENCEPHALITIS*

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FROM 1937 to 1942, 49 patients with acute encephalitis were treated with roentgen rays at the Cleveland Clinic; 29 patients recovered, 15 improved, 1 died, and 4 patients had no follow-up. The results were sufficiently encouraging to merit evaluation of the effectiveness of roentgen therapy as a method of treatment.

Specific viruses were recognized as causal agents in certain types of encephalitis after investigations of a peculiar infectious disease of the central nervous system which was epidemic in Rumania and France in the winter and spring of 1916–1917. A series of these cases was reported by von Economo,[3] and the disease was given the descriptive name "encephalitis lethargica." A somewhat similar epidemic appeared in the summer in Australia and was called "Australian X." Seven years later a severe epidemic of encephalitis occurred during the summer in Japan. Kaneko and Aoki,[1] investigating the epidemic, called attention to differences between winter and summer types of encephalitis, not only in seasonal incidence but also in certain clinical characteristics, and suggested that the winter form be called "Type A" and the summer form "Type B."

In the United States the first epidemic recognized as a specific virus type of encephalitis, the Japanese Type B, occurred in Paris, Illinois in the summer of 1933. A year later it appeared in St. Louis and elsewhere in the midwest. In 1938 encephalitis occurred epidemically east of the Appalachian Mountains and was especially severe in Massachusetts. This eastern type differed somewhat from the western in incidence, symptomatology, and mortality.

Both eastern and western types of encephalomyelitis have been recognized in animals and have been called "equine encephalitis" in horses and "louping ill" in sheep. Persons caring for animals with these diseases have contracted encephalitis.

In addition, encephalitis may be a sequel to measles, mumps, whooping cough, influenza, and vaccination against smallpox, with no definite seasonal incidence. Encephalitis or encephalomyelitis may also result from bacterial infections, syphilis, or poisoning from chemicals.

The different types of encephalitis vary considerably in mortality and morbidity. The mortality averaged approximately 30 per cent in several epidemics of the winter type, encephalitis lethargica, and 25 per cent of the survivors eventually developed parkinsonism. In the summer type, Type B or the St. Louis type, the mortality averaged about 20 per cent. Parkinsonism is not a sequel to this type. In the eastern or equine types the mortality has been as high as 60 per cent, and in a majority of survivors the central nervous system is severely damaged. Information is meager concerning the mortality and morbidity of encephalitis following other infectious diseases, but probably the mortality rate is relatively low.

The pathologic features of virus encephalitis vary according to the type, duration, and intensity of the disease. Each type is said to have characteristic pathologic features, but certain changes are common to all. Virus encephalitis is a nonpurulent inflammation of the brain and its coverings. In the acute stages there are varying degrees of hyperemia, hemorrhagic reactions, cellular infiltration, especially of lymphocytes, and proliferation of glia cells. In later stages various degenerative changes develop in blood vessels, nerve tissue, and meninges. These changes occur in scattered areas in the brain and its coverings and

* Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24–29, 1944.

according to their location and extent cause a diversity of symptoms and signs. For this reason no symptom or sign is pathognomonic of any type of encephalitis.

Diseases of the central nervous system which clinically resemble encephalitis and must be considered in the differential diagnosis are lymphocytic choriomeningitis, early disseminated encephalomyelitis, acute multiple sclerosis, spontaneous subarachnoid hemorrhage, subdural hematoma, brain tumor or abscess, atypical types of meningitis, and poliomyelitis.

A great many drugs have been employed in the treatment of acute and chronic encephalitis and encephalomyelitis without significant success. Very few reports about the value of roentgen therapy have been made. Nuvoli[13] in 1929 reported 18 cases treated in acute stages with good results in 11 observed for five years. He used rather high dosages, converging the irradiation through five 4 by 4 cm. fields to the mesencephalon. Apparently reactions were severe. In the same year von Wieser[19] reported benefits in 4 cases of acute encephalitis. In 1930 Trautmann and Pansdorf[17] reported no significant improvement from roentgen therapy for chronic encephalitis (Parkinson's disease). Also in 1930 Revello and Vallebona[14] discussed the difficulty of interpreting the results of roentgen therapy for acute encephalitis because spontaneous recovery occurs in many untreated cases. They were probably the first to produce bacterial encephalitis in rabbits by intracranial inoculations with the tubercle bacillus and *Staphylococcus albus*. They noted that heavy irradiation to the heads of the animals immediately reduced the inflammatory reactions caused by the inoculations but increased hemorrhagic reactions. They concluded that patients with encephalitis should be treated cautiously because of the possibility of hemorrhagic reaction; however, this condition in their animals may have been the result of inflammation caused by the infection.

In 1931 Kohlmann[8] reported good results from roentgen therapy in poliomyelitis and encephalitis. In 1932 Krause[9] reported 48 cases of acute and chronic encephalitis in which medical treatment was tried in some and roentgen therapy was given in others because (1) medical treatment had not been beneficial, and (2) the principal histologic change associated with acute encephalitis is radiosensitive round cell infiltration, the irritation of which produces young glia cells, which are also radiosensitive. Thirteen patients given light doses of roentgen therapy to the head at intervals of three or four days had symptomatic relief. Also in 1932 Lange and Schneider[10] reported that cases of chronic encephalitis were not benefited by roentgen therapy. They mentioned that Margolin as well as Engert and Hoff had attributed slight improvements to psychic effects in some cases of chronic encephalitis.

In 1934 Kiss and Szirmák[7] reported 8 cases of postencephalitic parkinsonism given moderate irradiation to the spinal sympathetic ganglia; 6 patients were so improved that they were able to return to work. Also in 1934 Goldberg, Baker and Hurff[5] described the essential lesions of encephalitis lethargica as a perivascular mantling of round cells, symptoms being caused primarily by pressure or circulatory disturbances. They concluded that rapid absorption of lymphocytes after irradiation relieved pressure and was responsible for the immediate alleviation of symptoms in 3 cases. They suggested that roentgen therapy might be beneficial for poliomyelitis and Landry's paralysis since the lesions of these diseases were similar to those of encephalitis.

In 1935 Goldberg, Brodie and Stanley[6] reported on experiments with the St. Louis strain of virus. From experiments with mice inoculated intranasally and then given irradiation, they concluded that roentgen therapy may either prevent or cure encephalitis. A report was made that year by Tachibana and Hasuo[16] on the results of roentgen therapy in Type B epidemic encephalitis; 5 of 11 patients reacted favorably. In writing about roentgen therapy for

diseases of the nervous system in 1936, Marburg and Sgalitzer[11] mentioned benefits in the treatment of encephalitis.

In reporting a series of animal experiments in 1937, Moore and Kersten[12] concluded that the St. Louis type of encephalitis virus "is inactivated by means of x-rays." Goldberg[4] published another article about benefits of roentgen therapy for encephalitis on the basis of experimental observations made previously. Also in 1937 Tucker[18] reported good results from the treatment of encephalitis by roentgen therapy and typhoid shock therapy. The cases he presented are included in this report. In 1937 vor der Brück[2] advocated roentgen therapy of the brain stem for chronic encephalitis, but his results were not convincing.

Rubenfeld and Wolf[15] in 1939 reported 7 cases of chronic encephalitis not benefited by roentgen therapy and 2 cases of acute encephalitis which were improved.

Of the 70 cases diagnosed encephalitis at the Cleveland Clinic between 1937 and 1940, 21 cases were subsequently proved to be diagnosed incorrectly. In the remaining 49 cases of acute encephalitis the results of roentgen therapy seemed worthy of investigation.

Examination and laboratory studies included clinical and neurologic examinations, routine urinalysis, blood counts, serologic tests, and special studies of the cerebrospinal fluid. The spinal fluid pressure and the total protein, globulin, and cell counts were increased in about one-half the cases; in the remaining cases the diagnosis was based upon clinical and neurologic examinations. Normal spinal fluid findings do not necessarily refute a diagnosis of encephalitis. At one time or in any one case the spinal fluid may be normal and at another time or in another case may be pathologic, probably depending upon the stage, focus, and intensity of the infection. Cultures of the blood and spinal fluid were not made routinely. They give no additional information in the virus type of encephalitis but are of considerable value in differentiating it and other bacterial inflammations of the central nervous system.

The most common symptoms in this series were low grade fever, headache, nausea or vomiting, vertigo, somnolence, and cranial nerve palsies causing ocular disturbances (diplopia) and speech disturbances (aphasia). Some seriously ill patients were in coma or had convulsions, monoplegia, or hemiplegia. No single patient had all these symptoms and signs, but each had different combinations of them in varying degrees.

TECHNIQUE OF ROENTGEN THERAPY

All cases were treated as other inflammatory processes might be treated, and the technical factors were substantially the same in every case (200 kv., 25 ma., focal skin distance, 50 cm., filter equivalent to half-value layer 0.8 mm. Cu, fields 15 by 15 cm.). The average skin dose was 75 to 100 roentgens to each side of the head, including the base of the skull, given daily or on alternate days, usually for a total of 300 r or less. The spine was treated in a few cases with evidence of encephalomyelitis. These comparatively small doses and one course of treatment seemed sufficient, though a few patients had a second course. Temporary partial epilation followed treatment occasionally, especially if dosages up to 400 r were necessary, but no other sequelae of importance were observed.

RESULTS

Lack of average response clinically in patients given roentgen therapy on the basis of an initial diagnosis of encephalitis suggested the probability that the diagnosis was incorrect. However, patients with an initial diagnosis of encephalitis were given roentgen therapy because many that did have encephalitis recovered promptly with early treatment and because treatment could not be harmful even though the diagnosis subsequently proved incorrect. Table 1 shows the diseases for which roentgen therapy was given on the basis of an incorrect initial diagnosis.

TABLE I

INITIAL DIAGNOSIS INCORRECT

	Cases
Tuberculous meningitis	3
Brain tumor	7
Brain abscess	1
Subdural hematoma	1
Early disseminated sclerosis	1
Acute syphilitic encephalomyelitis	1
Lymphocytic choriomeningitis	1
Undulant fever encephalomyelitis	1
Diabetic coma	1
Hysteria	4
TOTAL	21

The diagnosis of encephalitis proved to be correct in 49 patients given roentgen therapy on the basis of history, clinical examination, laboratory findings, and clinical course. None was considered to have any type of epidemic encephalitis. A small number had a definite history of previous infectious disease such as influenza or measles, but others had had no recent acute illness, so that the etiology in these cases was unknown. No patient had a positive Wassermann reaction. The spinal fluid showed increase in pressure, cell count (lymphocytes), globulin, and total protein in 26 cases (53 per cent). As previously stated, normal spinal fluid does not refute the diagnosis of encephalitis, although pathologic findings may be confirmatory. Table II shows the results of roentgen therapy in relation to the spinal fluid findings.

TABLE II

RESULTS OF ROENTGEN THERAPY FOR ACUTE ENCEPHALITIS

	Total Cases	Spinal Fluid	
		Pathologic	Normal
Recovered	29	15	14
Improved	15	7	8
Died	1	1	0
No follow-up	4	3	1
TOTAL	49	26	23

The 29 patients reported "recovered" are those that the referring clinicians considered benefited by roentgen therapy, because the course of the disease was shortened, and the patient had no residual symptoms or signs of disease of the central nervous system.

COMMENT

Some patients with encephalitis recover spontaneously. However, roentgen therapy produced an immediate and dramatic relief of symptoms and signs in many of our patients. Improvement began within two or three days, and most patients were discharged in about two weeks, though kept under observation. Because of normal cerebrospinal fluid findings in one-half the 29 patients who recovered, the question arises whether they might have recovered spontaneously. This seems unlikely because the spinal fluid was normal in other patients who did not recover but only improved. The spinal fluid was pathologic in the other half of the patients who recovered. This might indicate that they had more severe or extensive inflammation which might have caused permanent degenerative changes resulting in residual symptoms and signs if roentgen therapy had not been given. This explanation is plausible in view of the results in "improved" cases. Also it was quite apparent that patients treated in early stages of encephalitis recovered more promptly than those treated in later stages.

Fifteen patients were considered "improved"; they were relieved of some symptoms and signs of encephalitis by roentgen therapy but had evidence of permanent damage to the central nervous system. Half of these patients also had normal spinal fluid when first examined.

Two patients having normal spinal fluid initially had pathologic findings on subsequent examinations. When the spinal fluid was pathologic upon first examination, it continued to be so for several weeks or months, even though signs and symptoms improved.

In addition to roentgen therapy 5 of the patients who improved received injections of typhoid vaccine as reported by Tucker[18]

to "shake up the cells of the body and thus attenuate or destroy the virus." Two patients had typhoid shock injections before roentgen therapy, one during the course of treatment, another one month later, and a fourth one year later. It cannot be said that improvement was greater in these cases than in those given roentgen therapy alone, except possibly in 1 case. Tucker stated his conclusions, "Of the two methods, the best results follow radiation."

One of our patients died of encephalitis two years after treatment. Four patients are not available for follow-up: 1 left the hospital against advice before completion of treatment, and the results in 3 others are unknown.

Although none of the patients in this series was known to have epidemic encephalitis, some improvement from roentgen therapy might be expected in this type of disease. This is substantiated by the experiments of Goldberg, Brodie and Stanley and of Moore and Kersten, by the nature of the pathologic changes due to inflammation with which radiosensitive lymphocytic infiltration is associated, and by our experience and that of others in the treatment of somewhat similar types of encephalitis.

SUMMARY

The results of roentgen therapy in 49 cases of acute encephalitis were beneficial in a sufficiently large percentage to be encouraging; 59.1 per cent were considered recovered and 30.6 per cent improved.

The best results were obtained when roentgen therapy was given before degenerative changes were established in the central nervous system. No patient with a chronic form of encephalitis or with a post-encephalitic syndrome such as Parkinson's disease was definitely benefited by irradiation.

REFERENCES

1. Broun, G. O. Encephalitis and Other Virus Infections of the Central Nervous System. Oxford Medicine. H. A. Christian, Editor. Oxford University Press, New York, 1942, *6*, 69.
2. vor der Brück, G. Die Röntgenbestrahlung des Stammhirns und ihre Ergebnisse bei chronischer Encephalitis epidemica. *Psychiat.-neurol. Wchnschr.*, 1939, *41*, 305; 319.
3. von Economo, C. Encephalitis lethargica. *Wien. klin. Wchnschr.*, 1917, *30*, 591.
4. Goldberg, S. A. Roentgen therapy in cases of encephalitis. *Arch. Neurol. & Psychiat.*, 1937, *37*, 446–448.
5. Goldberg, S. A., Baker, C. F., and Hurff, J. W. Rationale of x-ray treatment in encephalitis lethargica. *Radiology*, 1934, *22*, 663–667.
6. Goldberg, S. A., Brodie, M., and Stanley, Phyllis. Effect of x-ray on experimental encephalitis in mice inoculated with St. Louis strain. *Proc. Soc. Exper. Biol. & Med.*, 1935, *32*, 587–590.
7. Kiss, N., and Szirmák, B. Roentgenotherapy of parkinsonism. *Orvosi hetil.*, 1934, *78*, 857–858.
8. Kohlmann. Die Röntgentherapie des Zentralnervensystems ausschliesslich der malignen Prozesse. *Strahlentherapie*, 1931, *42*, 453–465.
9. Krause, P. Röntgentherapeutische Versuche bei Kranken mit Enzephalitis und Folgezuständen. *Strahlentherapie*, 1932, *44*, 83–88.
10. Lange, W., and Schneider, W. Ergebnisse der Röntgenbestrahlung bei chronischer Encephalitis epidemica. *Psychiat.-neurol. Wchnschr.*, 1932, *34*, 7–9.
11. Marburg, D., and Sgalitzer, M. Röntgenbehandlung der Nervenkrankheiten. In: Bumke, O., and Foerster, O., Editors. Handbuch der Neurologie. Band viii. J. Springer, Berlin, 1936.
12. Moore, Helen N., and Kersten, H. Inactivation of encephalitis virus (St. Louis type) by means of soft x-rays. *J. Bact.*, 1937, *33*, 615–618.
13. Nuvoli, U. La radioterapia dell'encefalite epidemica nel suo stadio aduto. *Policlinico* (sez. med.), 1929, *36*, 177–194.
14. Revello, M., and Vallebona, A. Irradiazone Roentgen e focolaio encephalitico sperimentale. *Pathologica*, 1930, *22*, 259–264.
15. Rubenfeld, S., and Wolf, A. Treatment of encephalitis with roentgen ray; preliminary report. Am. J. Roentgenol. & Rad. Therapy, 1939, *42*, 561–564.
16. Tachibana, S., and Hasuo, H. Ueber die Röntgenstrahlenbehandlung bei Encephalitis epidemica Typus B. *Fukuoka acta med.* (Abstr. sect.), 1935, *28*, 125–126.
17. Trautmann, E., and Pansdorf, H. Versuch einer Röntgenbehandlung der chronischen Encephalitis. Gleichzeitig ein Beitrag zur Frage der Wirkung der Röntgenstrahlen auf Entzündungsvorgänge im Gehirn. *Klin. Wchnschr.*, 1930, *9*, 1444–1447.

18. TUCKER, J. Some observations in treatment of acute encephalitis by roentgen therapy and typhoid shock reactions. *Cleveland Clin. Quart.*, 1939, *6*, 134–139.

19. VON WIESER, W. Weitere Erfahrungen mit der Röntgentherapie bei psychiatrischen und neurologischen Erkrankungen. Folgezustände nach Encephalitis epidemica; vorläufige Mitteilung. *Strahlentherapie*, 1929, *33*, 380–381.

DISCUSSION

DR. HENRY J. ULLMANN, Santa Barbara, Calif. When I was asked to open this discussion in the absence of Dr. Jenkinson, I felt very much as I did some years ago when I was asked to take the subject of supervoltage and its possible effects on tumors, at the meeting of the American Association for the Advancement of Science, at Pasadena, where the first million volt tube had just been installed. I knew nothing about it.

One would expect beneficial effects of irradiation on almost any inflammatory reaction. My experience with this condition has been with the postencephalitis syndrome, not parkinsonism. One patient, whom I remember very well, had attacks of vertigo and headaches which were steadily increasing. These came on some months after her encephalitis, and when it was thought that she was well and able to return to her work as a nurse technician. She became practically incapacitated from these attacks. She was treated almost exactly as Dr. Portmann has described, with complete relief, and it is now over four years since her treatment. She is entirely free from symptoms and working hard.

One would expect beneficial effects in any inflammatory reaction because of the known effect of irradiation on such conditions. Roentgen irradiation reduces hyperemia and reduces or inhibits the formation of allergens, and while it also inhibits or reduces the formation of antibodies, it also prevents their destruction or excretion if once formed.

I bring this up as a warning, for if we are going to use irradiation in conjunction with antigens, the antigens must be given first; that is, the antibodies must be allowed to form before the irradiation is given. I should like to ask Dr. Portmann how early in the attacks he has given his irradiation, and also how late. I should also like to know if any of Dr. Portmann's patients had received any of the sulfonamides before the irradiation was given, because today, even in virus infections, somebody always fills the patients full of these drugs. One must expect that.

I was particularly anxious to hear this paper because we will probably have more encephalitis cases and because it confirms my feeling that irradiation can be used much more extensively than it has been in almost any inflammatory condition.

DR. PORTMANN (closing). I want to thank Dr. Ullmann for his extemporaneous discussion of this paper.

The question was asked in what stage of the disease the patients were when treated. Most of them had had evidences of encephalitis for two weeks and some for as long as two months. We considered them to be in the acute or subacute stages. After degenerative changes have taken place in the central nervous system, I doubt that irradiation will be beneficial, but it might stop the progress of the disease.

The question was asked about the use of sulfa drugs. These drugs were not administered to our patients during or after irradiation, though it is possible that some patients received them prior to admission to our hospital.

Vol. 53, No. 6

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Publisher: Charles C Thomas, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application: Editorial office, 110 Professional Building, Detroit, Mich., Office of publication, 301–327 East Lawrence Avenue, Springfield, Ill. Information of interest to all readers will be found on page iv.

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Twenty-eighth Annual Meeting: 1945, canceled.

EDITORIAL

THE ROENTGENOLOGIC EXAMINATION OF THE SMALL INTESTINE

IT IS quite singular that a comprehensive roentgenological study of so important a segment of the gastrointestinal tract as the small intestine, which plays such an important part in the body economy, should have been delayed so long. However, advancements in this field have only been made possible by a knowledge of the normal physiology and chemistry of the small intestine, and Golden is to be congratulated that he seized upon this knowledge at the earliest possible moment and put it to practical use in roentgen studies of the gastrointestinal tract, which offer a means of approach toward the unraveling of some of the clinical problems dealing with digestive disorders.

The book by Golden[1] which has recently been issued by Lippincott marks a milestone in the advance of roentgenology. In this he calls attention to a much neglected study in roentgen examinations of the gastrointestinal tract. When one realizes that it is only nine years since Barclay[2] published his epoch-making book on "The Digestive Tract" in which he covered in five pages in a volume of some four hundred pages our knowledge and methods of roentgen examination of the small intestine as known at that time, we may readily appreciate how much progress we have made in the study of this part of the digestive tract.

In his preface Golden points out that "the basic facts concerning the action and control of the small intestine are of importance to the surgeon and internist who have to deal with the problems of abdominal diagnosis and the treatment of intestinal disorders." And furthermore, "Familiarity with these facts is even more important for the radiologist who tries to study this complex structure by roentgen methods."

The content of his book is sufficient evidence that Golden possesses a familiarity with these facts as a roentgenologist far greater than that of roentgenologists in general. He has produced a book that should become the constant companion of every roentgenologist who hopes to qualify as such, since the roentgen method of examination is valued in direct proportion to the roentgenologist's knowledge of the possible departures from the normal pattern in which the small intestine expresses itself and his ability to interpret these abnormal findings in clinical terms.

In every field of roentgenologic examination a sympathetic approach to the clinical problem involved must be constantly kept in mind and, as Golden says, in the field of roentgen examination of the small intestine this cooperative understanding is of the utmost importance; while the roentgenologist may demonstrate variations from the normal appearance of the small intestinal pattern the full significance of these pattern changes cannot always be thoroughly understood but "this should be a stimulating rather than a discouraging aspect of the problem."

That the roentgenologic study of the small intestine is in its early stages may be thoroughly accepted, but when one studies this book there is a realization that we have made enormous progress in this particular field within the last few years. A mere pe-

[1] Golden, Ross. Radiologic Examination of the Small Intestine. J. B. Lippincott Company, Philadelphia, 1945.

[2] Barclay, A. E. The Digestive Tract: A Radiological Study of its Anatomy, Physiology, and Pathology. Second edition. University Press, Cambridge, 1936.

rusal of the table of contents indicates the wealth of material which it contains. Beginning with "Indications for a small intestine study," together with "Technic" of the examination, it passes by easy stages over the "Embryology, anatomy, and physiology of the normal small intestine," continuing with "The normal small intestine on roentgen examination," "The small intestine of the infant," "Peritoneal adhesions and ileus," and a very splendidly written chapter on "The Miller-Abbott tube in the diagnosis and treatment of ileus." The chapter on "Disorders of nutrition" represents a high water mark in the study of gastrointestinal disorders in which recent developments in pathology and physiology are discussed, exposing not only known physiological facts concerning the small intestine but pointing to new fields of study dealing with its physiologic mechanism.

Golden, in his early studies on the small intestine, particularly those dealing with disorders of nutrition, coined the term "deficiency pattern." He says that this expression is inadequate and he suggests "Disordered motor function" as more descriptive and inclusive, as it carries with it no etiologic implications. The abnormal mucosal pattern is evidence of abnormal motor function of the muscularis mucosae just as the segmentation is due to disorderly action of the tunica muscularis. Disordered motor function of the small intestine is nonspecific, and may be due to a number of different causes, and since this book will undoubtedly be the source of information dealing with the roentgen examination of the small intestine it would be well for the nomenclature used in these descriptive terms to become common knowledge.

There are other chapters of great importance, dealing with diseases of the mesentery, and the expression of the small intestine pattern changes incident to allergy, and a thorough discussion of the well known inflammatory processes which involve the small intestine is included. There is an excellent chapter on the effects of certain drugs, namely morphine, strychnine, atropine, benzedrine, and the barbiturates, and a whole host of miscellaneous conditions are admirably grouped in some of the final chapters of this very stimulating study.

It is no exaggeration to say that no more important or thought-provoking book has been issued in the field of roentgenology than Golden's present volume. Here he has gathered together an enormous amount of material which represents his own keen observations on the studies of the gastrointestinal tract, and which also makes available in a very concise manner the work of other investigators. To have produced and published such a book even in normal times would deserve the gratitude of all roentgenologists but such an accomplishment under the stress of war conditions makes us doubly grateful. Such a book would not have been possible without a thorough knowledge of the recent advances in physiology, neurology and chemical changes during the digestive processes. The author is at great pains to emphasize that this book does not represent in any way the final chapter on this subject and he indicates in many places the gaps in our knowledge of normal motor functions as well as disordered motor functions of the small intestine. However, the volume with its systematic assemblage of known facts is a timely aid in our present needs in the study of small intestinal diseases and represents a foundation stone upon which future study and progress of roentgenologic examinations of the small intestine will be predicated.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: 1945, canceled.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio. Annual meeting: 1945, canceled.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. J. S. Wilson, Mack Wilson Hospital, Monticello, Ark. Meets every three months and also at time and place of State Medical Association.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: 1945, to be announced.

RADIOLOGICAL SECTION, BALTIMORE MEDICAL SOCIETY
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

SECTION ON RADIOLOGY, CALIFORNIA MEDICAL ASSOCIATION
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RADIOLOGICAL SECTION, CONNECTICUT MEDICAL SOCIETY
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RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL ASSOCIATION
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RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
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BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. Leo Harrington, 880 Ocean Ave., Brooklyn, N.Y. Meets monthly on fourth Tuesday, October to April.

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Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. F. H. Squire, 1754 W. Congress St., Chicago 12, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. D. D. Brannan, 11311 Shaker Blvd., Cleveland 4, Ohio. Meets at 6:30 P.M. at Allerton Hotel on fourth Monday each month, October to April, inclusive.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meetings held in Dallas on odd months and in Fort Worth on even months, on third Monday, at 7:30 P.M.

DENVER RADIOLOGICAL CLUB
Secretary, Dr. A. Page Jackson, Jr., 1612 Tremont Place, Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

FLORIDA RADIOLOGICAL SOCIETY
Acting Secretary, Dr. Walter A. Weed, 204 Exchange Bldg., Orlando, Fla. Meetings in May and November.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. H. C. Ochsner, Methodist Hospital, Indianapolis. Meets annually second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

LONG ISLAND RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

NEBRASKA RADIOLOGICAL SOCIETY
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

NEW HAMPSHIRE ROENTGEN RAY SOCIETY
Secretary, Dr. Richard C. Batt, Berlin, N. H. Four meetings a year.

RADIOLOGICAL SOCIETY OF NEW JERSEY
Secretary, Dr. H. R. Brindle, 501 Grand Ave., Asbury Pk. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
Secretary, Dr. Major Fleming, Rocky Mount, N. C. An-

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

nual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

North Dakota Radiological Society
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

Central New York Roentgen Ray Society
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

Ohio Radiological Society
Secretary, Dr. Henry Snow, 1061 Reibold Bldg., Dayton, Ohio. Meets during annual meeting of Ohio State Medical Association.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. R. P. Barden, University Hospital, Meetings first Thursday of each month from October to May inclusive at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Pittsburgh Roentgen Society
Secretary, Dr. L. M. J. Freedman, 4800 Friendship Ave. Meets second Wednesday each month, 4:30 P.M., October to June, Pittsburgh Academy of Medicine.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary Dr. A.M. Popma, 220 N. First St., Boise, Idaho.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September, at a place designated by the president.

San Diego Roentgen Society
Secretary, Dr. Henry L. Jaffe, Naval Hospital, Balboa Park, San Diego, Calif. Meets monthly on first Wednesday at dinner.

San Francisco Radiological Society
Secretary, Dr. Carlton L. Ould, University of California Hospital, San Francisco 22. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year at Lane Hall, Stanford University Hospital, and second six months at Toland Hall, University of California Hospital.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. Asa E. Seeds, Baylor Hospital, Dallas, Texas. Next annual meeting, Temple, Texas, Jan. 17, 1945.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

Virginia Radiological Society
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-ray Study Club of San Francisco
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly, third Thursday evening.

Cuba

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month at 4:45 P.M. at the Royal Society of Medicine 1, Wimpole St., London, W. 1.

Faculty of Radiologists
Secretary, Dr. M. H. Jupe, 32 Welbeck St., London, W. 1 England.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

Canadian Association of Radiologists
Secretary, Dr. J. W. McKay, 1620 Cedar Ave., Montreal, P. Q.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

South America

Sociedad Argentina de Radiologia
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

Sociedad Peruana de Radiologia
Secretary, Dr. Victor Giannoni, Apartado, 2306, Lima, Peru. Meetings held monthly except during January, February and March, at the Asociación Médica Peruana "Daniel A. Carrión, Villalta, 218, Lima.

Continental Europe

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse Biel. Meets annually in different cities.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

DEPARTMENT OF TECHNIQUE

Department Editor: ROBERT B. TAFT, M.D., B.S., M.A., 103 Rutledge Ave.
Charleston, S. C.

SPOT FILM FLUOROROENTGENOGRAPHY WITH MOVABLE GRID

By JACOB BUCKSTEIN, M.D.
Assistant Professor of Clinical Medicine, Cornell University Medical College
NEW YORK, NEW YORK

THE value of fixing on the film the exact area of any part of the alimentary tract as observed roentgenoscopically is unquestioned. By this technique it becomes possible to roentgenograph an area when it shows to best advantage. By means of graded pressure it also becomes possible to produce that proper thinning of the opaque medium which will permit the visualization of lesions which might otherwise be obscured. An apparatus, therefore, which permits of graded compression and almost instantaneous fixation on the film of an area observed under roentgenoscopic guidance has obvious merit and the procedure has achieved full recognition, although far from universal application.

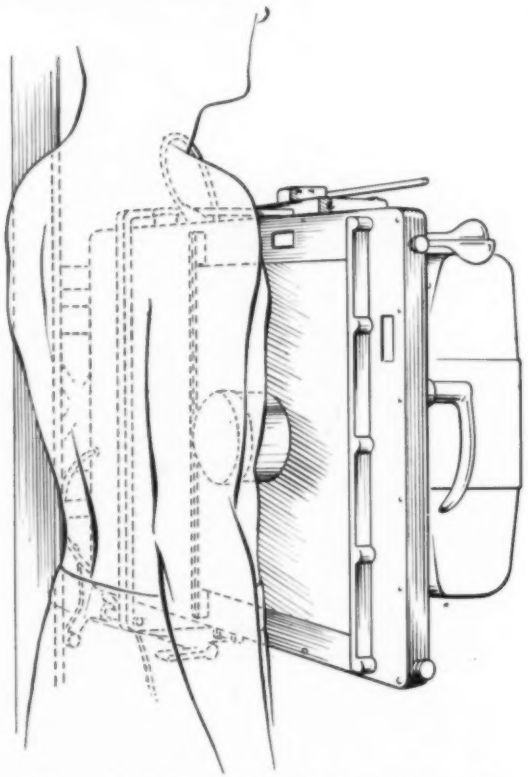


FIG. 1. Showing spot film device with cone in place against the abdomen.

A grid attached to the roentgenoscope is of great value in clarifying the image and bringing out maximum detail and should be a permanent part of any screen in roentgenoscopy of the alimentary tract. When the grid is fixed permanently to the fluorescent screen and the apparatus is used for immediate switch over for roentgenographic exposure, a good roentgenogram will be obtained which, however, is marred by the lines of the grid. It therefore occurred to me that if an arrangement could be made so that the grid would be in place

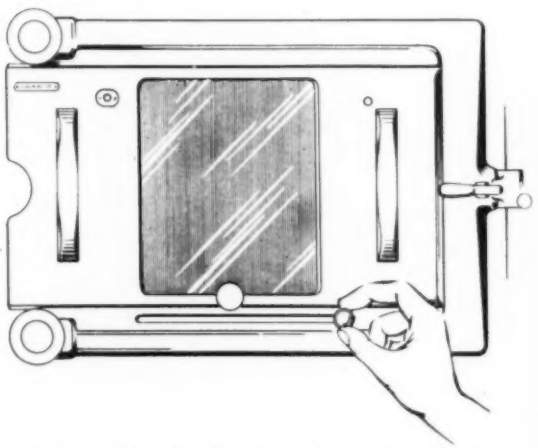


FIG. 2. Showing hand on the knob with the movable grid still in place.

during roentgenoscopic study, and at the same time could be moved rapidly out of the way, simultaneously with roentgenographic exposure, it would then be possible to obtain a roentgenogram equal in quality to that obtained with the grid in place without the disadvantage of the grid lines.

Figure 1 shows the spot film device with cone in place against the abdomen. Figure 2 shows the grid in place in front of the fluorescent screen. This is the position of the grid during roentgenoscopy. When the area under observation is noted which it is desired to roentgenograph, the cone is moved into place so that it covers the exact area and graded compression is applied to bring out maximum detail. One may then by means of the switch-over mechanism promptly roentgenograph the desired area with the grid in place. As already stated, an excellent roentgenogram of the desired part may be obtained in this manner. The lines of the grid, however, will show and somewhat mar its appearance or even partially obscure some fine detail.

I therefore devised a simple method whereby the grid could be rapidly moved out of place after the roentgenoscopic examination had been completed and the area under observation fixed by the compression cone. The pressure of a button promptly releases a loaded cassette which shifts into position and simultaneously changes the setting from roentgenoscopic to roentgenographic exposure. The grid may be moved back and forth by an extremely simple mechanism through attachment to an external small metal knob which moves in a narrow horizontal slot. Figure 2 shows the hand attached to the knob with the grid still in place. Figure 3 shows the grid in transit as the hand moves the knob through the slot from right to left. Figure 4 shows the completed motion with the grid entirely out of the field of examination.

Roentgenographic examination with elimination of the grid lines may then be made in two ways. First, the movement of the grid can be started, preferably with the left hand, and roentgenographic exposure made by contact of the switch with the right foot while the grid is in transit. With a little practice these two movements can be carried out almost simultaneously. In this

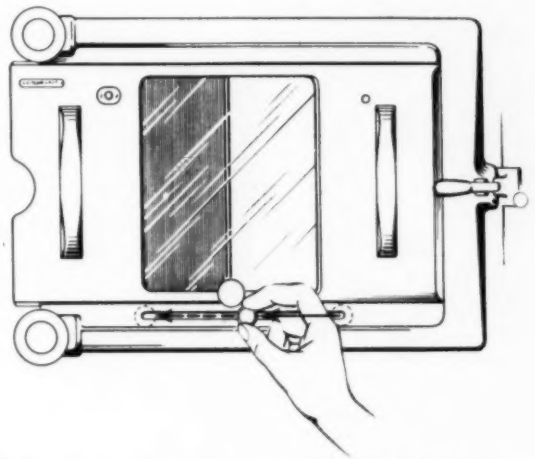


Fig. 3. Showing the grid in transit as the hand moves the knob through the slot from right to left.

manner secondary radiation is eliminated similar to the principle of the rapidly moving Potter-Bucky grid in general, and an excellent roentgenogram is obtained, at least the equal of the roentgenogram with the stationary grid. Another way in which a roentgenographic exposure may be made is first to rapidly move the grid completely

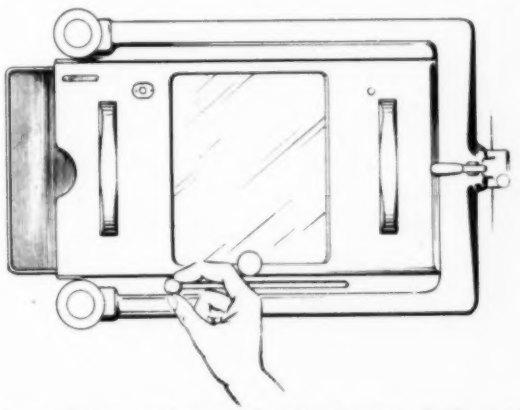


Fig. 4. Showing the completed motion with the grid entirely out of the field of examination.

out of the field and then step on the foot switch. Of these two procedures I prefer the former, since the roentgenogram so obtained is not only free of grid lines but shows better contrast.

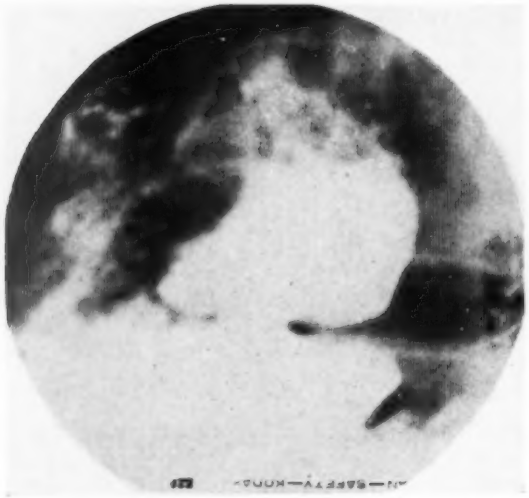


Fig. 5. Appearance of spot roentgenogram of duodenal bulb with the grid in place. Note presence of grid lines.

Fig. 6. Spot roentgenogram of the same duodenal bulb as in Figure 5, exposure being made while the grid is in transit. Note absence of grid lines.

The movable grid thus adds greater flexibility to the spot film device, permitting roentgenographic exposures to be made under roentgenoscopic control (*a*) with the grid permanently in place, (*b*) during the actual movement of the grid across the field of exposure, and (*c*) after first completely moving the grid out of the field.

Figure 5 shows the appearance of a spot roentgenogram of the duodenum with the grid in place. The lines of the stationary grid are thereby included in the roentgenogram. Figure 6 shows a spot roentgenogram of the same area made simultaneously with the motion of the grid across the field of exposure. The grid lines do not show. On completion of the exposure the grid can then be shifted back to its original place in front of the screen for further roentgenoscopic observation.*

1150 Fifth Ave.
New York, N. Y.

* I am indebted to the Westinghouse Electric and Manufacturing Co. for their cooperation in the construction of this innovation.

Vol. 53, No. 6

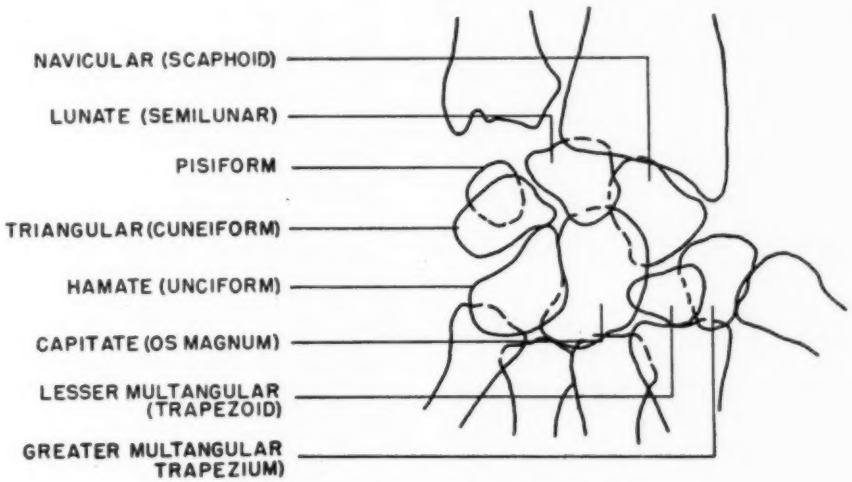
THE ROENTGENOGRAPHIC EXAMINATION OF THE CARPUS

By J. F. RODERICK,* R.T.
CHICAGO, ILLINOIS

ROENTGENOLOGISTS have evolved series of positions which are designed to demonstrate thoroughly the anatomy under examination in many regions of the human body. After a study to determine the most widely preferred positions with which to examine the carpus, the conclusion was reached that there is no generally accepted series of positions to supplement the standard posteroanterior and mediolateral projections.

In order to determine what minimum number of positions will demonstrate all of the carpal bones and joints, a normal wrist was examined using a total of fifty roentgenographic projections. The series was made with angulations of the central ray from the tube in proximal, distal, medial and lateral directions. The wrist was examined in various degrees of rotation, with and without deviation of the hand, with mediolateral and lateromedial positions with extension and flexion, and in posteroanterior and anteroposterior positions with and without extension and flexion and with axial projections.

The resulting roentgenograms were presented to various roentgenologists for their study and opinions. It was concluded that at least five projections are required to make a complete examination of the carpus. These five projections were selected on the value of the series to show each carpal bone in one or more perspectives, the relationship of each carpal bone to the surrounding structures, and to outline the articular surfaces and interspaces.



Drawing of the carpus in dorsivolar projection.

Consideration for the patient with a severe and painful injury to the wrist region usually suggests the use of posteroanterior and lateromedial positions. The following positions are offered as a supplemental examination where the condition of the patient will permit using them and where a more complete examination is indicated.

1. *Posteroanterior View* (Fig. 1). The wrist is placed in pronation with ulnar

* From the Technical Service Department, General Electric X-ray Corporation, Chicago, Ill.

FIG. 1. Posteroanterior view of the carpus.

FIG. 2. Oblique, posteroanterior view of the carpus.

deviation. The central ray from the tube is directed perpendicularly to the plane of the part and to the plane of the film. The centering point for the central ray is one-half inch distal to the mid-point of the interstyloid line.

If the mobility of the part permits ulnar deviation, a satisfactory view of the carpal bones and their interspaces is obtained. The

FIG. 3. Oblique, anteroposterior view of the carpus.

navicular and greater multangular bones are particularly well demonstrated. The lunate-triangular, capitate-hamate and the carpal-metacarpal interspaces are well defined.

With no ulnar deviation a slightly better view of the hamate is obtainable. However, there is an increase in superimposition which minimizes the visualization of the navicular and greater multangular bones. The interspaces are not clearly defined without an ulnar deviation.

2. *Oblique, Posteroanterior View* (Fig. 2). From the lateral position, with the medial side next to the film, the wrist is rotated

internally toward pronation until the volar surface is at a 45° angle to the plane of the film. The wrist is then deviated in the direction of the ulna. The central ray is directed perpendicularly to the center of the film through a point one-half inch distal to the center of the interstyloid line.

The proximal row of carpals is well defined. The greater and lesser multangulars and the proximal portion of the capitate is better visualized in this position than in routine positions. The following interspaces are well illustrated: navicular-greater multangular, greater multangular-first metacarpal and greater multangular-lesser multangular. Although some superimposition exists, this projection also demonstrates the articulation between the distal row of carpals and the first four metacarpals.

3. *Oblique, Anteroposterior View* (Fig. 3). From the lateral position with the ulna next to the film the wrist is rotated externally, toward supination, until the dorsal surface forms a 45° angle with the film plane. The wrist is deviated toward the ulna. The central ray from the roentgen tube is directed perpendicularly to the plane of the film, passing through a centering point one-half inch distal to the mid-point of the interstyloid line and then to the center of the film.

Fig. 4. Lateral, mediolateral view of the carpus.

Fig. 5. Axial view of the carpus.

This roentgenographic projection demonstrates the proximal row of carpal bones with a minimum of superimposition and illustrates the relationship of the proximal row of carpal bones to those bones with which they articulate. The navicular, lunate, triangular and pisiform are particularly well defined.

The following articulating surfaces are well outlined: navicular-radius, lunate-radius, capitate-lunate, hamate-lunate, navicular-greater multangular and triangular-pisiform.

4. *Lateral, Mediolateral View* (Fig. 4). The forearm is placed in extreme internal rotation to bring the radial side next to the film and the dorsal surface at right angles to the plane of the film. The central ray is perpendicular to the film and is directed

through the styloid process of the ulna to the center of the film.

Although superimposition is present, the position permits a satisfactory lateral view of the following bones: navicular, lunate, triangular, greater multangular, capitate and hamate. The following interspaces are also demonstrated: first metacarpal-greater multangular, navicular-greater multangular, capitate-lunate, lunate-radius and navicular-radius.

5. *Axial View* (Fig. 5). The forearm is placed in pronation and in contact with the film. The wrist is extended and held in position by the patient. The degree of extension is dependent upon the mobility of the part, but a 90° extension is desirable. The central ray is directed at a 45° angle to the volar surface of the hand and passes through the mid-point of the interstyloid line to the center of the film.

This position offers a supplementary examination of the pisiform, the process of the hamate, the lesser multangular and the greater multangular bones.

I wish to express my gratitude to the following roentgenologists whose comments and opinions have been especially valuable in the selection and preparation of this material: Charles W. Blackett, M.D., Bay State Road, Boston, Massachusetts, and Leonard Long, M.D., Caylor-Nickel Clinic, Bluffton, Indiana.

REFERENCES

1. APPLETON, A. B., HAMILTON, W. J., and TCHAPEROFF, I. C. C. Surface and Radiological Anatomy for Students and General Practitioners. William Wood & Co., Baltimore, 1938, pp. 49–51, 62–66, 71–73.
2. FILES, G. W. Medical Radiographic Technic. Charles C Thomas, Springfield, Ill., 1943, pp. 213–215.
3. GRANT, J. C. B. An Atlas of Anatomy in One Volume. Williams & Wilkins Co., Baltimore. Reprinted 1944, pp. 42, 57–61.
4. GRAY, HENRY. Anatomy of the Human Body. Twenty-fourth Edition. Lea & Febiger, Philadelphia, 1944, pp. 212–218.
5. MCNEILL, CLYDE. Roentgen Technique. Charles C Thomas, Springfield, Ill., 1941, pp. 102–105.
6. NAVAL MEDICAL SCHOOL. Fundamentals of X-Ray Physics and Technique. National Naval Medical Center, Bethesda, 1944, pp. 79–80.
7. RHINEHART, D. A. Roentgenographic Technique. Third edition. Lea & Febiger, Philadelphia, 1943, pp. 224–227.
8. SANTE, L. R. Manual of Roentgenological Technique. Tenth revised edition. Edwards Brothers, Inc., Ann Arbor, Mich., 1943, pp. 76–78.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

COAKLEY, WALTER A., and WHITE, MALVIN F. Fractures of the zygoma. *Surg., Gynec. & Obst.*, Oct., 1943, *77*, 360–366.

This paper represents a comprehensive study of 72 consecutive cases of fracture of the zygoma admitted to Kings County Hospital during the three year period from July, 1939, to June, 1942.

These fractures were always due to direct violence. The most important single cause was a vehicle accident. Sixty per cent of all the cases occurred in the age group ranging from twenty to thirty-eight years. The fractures had a preponderance in the male sex. The ratio of left sided injury to right was 3.5:1. There was an average of 3 fractures to each zygoma. The most frequent sites of fracture together with the incidence of their occurrence were as follows: arch, 119 times; infra-orbital, 44 times; frontal, 23 times; maxillary, 21 times.

Signs and Symptoms. (1) Periorbital swelling and ecchymosis; (2) local tenderness on palpation; (3) palpable depression or irregularity of contour; (4) pain—constant; (5) pain on mastication; (6) asymmetry between left and right sides on finger palpation intraorally between ramus of mandible and the maxilla; (7) epistaxis; (8) sensory changes over distribution of infra-orbital nerve; (9) conjunctival hemorrhage; (10) visual disturbances; (11) visible depression; (12) headache; (13) drooping of face and lip; (14) difficulty in opening mouth; (15) dizziness; (16) mobility or crepitus; (17) subcutaneous emphysema.

Reduction of Fracture. In general, fractures of the zygoma should be reduced immediately before swelling begins, or if that is impossible, it is better to wait five or six days until the swelling subsides. Two methods of operative approach have proved most useful in reducing these fractures: the temporal and the intraoral. —*Mary Frances Vastine.*

SAUNDERS, WM. W. Basilar impression: the position of the normal odontoid. *Radiology*, Dec., 1943, *41*, 589–590.

The syndrome called basilar impression includes symptoms resembling those of syringomyelia, progressive spastic paralysis or multiple sclerosis in the region of the upper cervical cord and medulla, and shortening of the neck. Chamberlain holds that the diagnosis must be made by the roentgenologist on the basis of changes in the relations at the base of the skull, including displacement of the atlas and the tip of the odontoid process above their normal positions.

Lateral roentgenograms of the skulls of 100 normal persons were made to determine what the normal position of the odontoid process is. It was found to be 1 mm. below Chamberlain's line which runs from the dorsum of the hard palate to the dorsum of the foramen magnum. The standard deviation is 3.6 mm. In cases of any considerable deviation a careful examination of the foramen magnum should be made.—*Audrey G. Morgan.*

LAWSON, LAWRENCE T. Primary carcinoma of the eustachian tube; a study of the evidence of its occurrence. *Ann. Otol., Rhin., & Laryng.*, June, 1943, *52*, 377–390.

Thirteen cases of primary carcinoma of the eustachian tube which have been reported in the literature are reviewed and the author adds a case report of his own. There is a discussion of the 14 cases from the following standpoints:

1. The symptoms of lateral wall nasopharyngeal tumor include:
   a. Pain due to irritation of the first and second branches of the fifth nerve.
   b. Post-nasal bleeding.
   c. Nasal obstruction.
   d. Obstruction of the eustachian tube with tinnitus and deafness and often—
   e. Painless unilateral cervical adenopathy.
   f. Symptoms referable to any of the cranial nerves other than the first and

second divisions of the fifth are an indication of extension of the tumor through the basal foramina, the jugular foramen or the orbital fissure.

2. Age and sex incidence. In this series of 14 cases, there were 13 men (ages 32 to 68) and 1 woman (age 54).
3. Pathology. In most instances, the neoplasm arises from the cartilaginous portion of the tube. According to Salinger and Pearlman, most of these tumors are thought to be transitional cell carcinomas or lympho-epitheliomas.
4. Clinical features. Symptoms referable to the ear were present in all cases. Intractable pain was present as the disease progressed.
5. Physical findings. There was early evidence of tumor involvement of the eustachian tube in 9 cases. Complete obstruction of the tube was present in 6 cases.
6. Treatment. The most favorable treatment would appear to be deep roentgen treatment combined with radium or radon.—*Mary Frances Vastine.*

NECK AND CHEST

Cooper, William G., Jr., and Ackerman, Lauren V. Cystosarcoma phylloides, with consideration of its more malignant variant. *Surg., Gynec. & Obst.*, Sept., 1943, *77*, 279–283.

Three cases of cystosarcoma phylloides of the female breast are reported.

Definition. Cystosarcoma phylloides is a tumor arising from the connective tissue of a pre-existing mammary adenofibroma.

Clinical History. The patient in her fourth or fifth decade has been aware of a quiescent, small, hard breast nodule for many years with later growth to a huge size without associated constitutional symptoms.

Examination. The breast is tremendously enlarged and characteristically ovoid in shape. The overlying skin and nipple are not invaded, although local extension may have taken place to the adjacent structures. Regional lymphadenopathy is not evident unless infection is superimposed.

Pathology. Grossly, the tumor is seen to contain frond-like pleats resembling a head of cauliflower. Microscopically, the characteristic finding is the increase in the fibrous elements.

Prognosis. Cystosarcoma of the breast is, like all neoplasms, one whose potentialities vary from that of a very benign to that of a very malignant lesion.

Treatment. Treatment by wide local excision is usually satisfactory.—*Mary Frances Vastine.*

Berman, J. K. Nontuberculous empyema thoracis in children. *Surg., Gynec. & Obst.*, Feb., 1943, *76*, 183–188.

A study of 184 cases of empyema before and since the use of the sulfonamides reveals the following observations:

1. The incidence of the disease varies from year to year and is apparently uninfluenced by their use.
2. There is a greater incidence of localized types of empyema.
3. Streptococcic and staphylococcic varieties are not as serious as formerly.
4. The stay in the hospital is prolonged.
5. The mortality is much less.
6. Complications are less frequent.

Roentgenoscopy is important to determine (1) whether or not localization has occurred and (2) the position of the encapsulated and interlobar varieties of empyemas. The method is based upon the fact that with localization comes fixation of the walls of the empyema cavity. In children, empyemas are usually massive so that fixation of the movable diaphragm and mediastinum are accurate guides. The mediastinum does not change as much in adults. However, even in localized cavities the phenomenon of fixation of the surrounding lung can be demonstrated.

In the child with empyema a thoracentesis is done to determine the type of organism, to partially empty the cavity of pus, and also to inject air. Roentgenoscopy is now done. It includes three maneuvers:

1. The child is first observed in the upright position. The fluid level is easily seen and before localization moves with respiration. It descends with the diaphragm on inspiration and ascends on expiration. After localization two phenomena have been observed: (*a*) no movement—this is seen in bilateral and sometimes unilateral empyema; (*b*) paradoxical movement—this is seen in unilateral empyema due to an exaggerated movement of the opposite leaf of the diaphragm.
2. The child is next observed in the Trendelenburg position (head down). In this

position the diaphragm can be seen easily if a sufficient amount of air is present in the empyema cavity (20 to 30 cc. of pus or more must be aspirated and an equal amount of air injected for visualization of the diaphragm). Fixation of the diaphragm implies localization.

3. The third maneuver includes examination of the child anteroposteriorly in the lateral decubitus plane. The pus gravitates away from the mediastinum permitting observation of its movements when the patient is turned on the affected side. If the mediastinum is fixed the cavity is completely localized and open drainage may be safely done.—*Mary Frances Vastine.*

Clagett, O. Theron. Relationship between the thymus and myasthenia gravis. Editorial. *Surg., Gynec. & Obst.*, Feb., 1943, *76*, 250–252.

Evidence of an association between myasthenia gravis and abnormalities of the thymus has been accumulating since 1901 when Weigert reported finding a tumor of the thymus in postmortem examination of a patient who had died with myasthenia gravis. At the Mayo Clinic in the past year 7 patients having myasthenia gravis were found to have roentgenographic evidence of intrathoracic tumors. In 3 instances surgical removal and histological study verified the clinical opinion that the tumors were of thymic origin.

The exact nature of the relationship is not known but the association occurs too frequently to be considered coincidental. There is some evidence to suggest that myasthenia gravis may be an endocrine type of disease due to an abnormal secretion from the thymus having a curare-like effect. Further evidence that the thymus may be a part of the endocrine system is contributed by the fact that in thyrotoxicosis and in Addison's disease the thymus is enlarged and that it undergoes an involution following thyroidectomy in cases of thyrotoxicosis or injection of cortical extract in Addison's disease. Likewise the gonads and the pituitary gland have been shown by some to have some definite influence on the thymus.

Although the rôle of roentgen irradiation of the thymus in the treatment of myasthenia gravis is not established, a number of observers have noted that roentgen therapy over the thymic region in cases of myasthenia gravis has produced improvement or remission of symptoms, and in some cases definite roentgenologic evidence of thymic enlargement disappeared following roentgen therapy. The author's own experience has confirmed the beneficial effects of roentgen therapy for the relief of symptoms of myasthenia gravis in selected cases.—*Mary Frances Vastine.*

Gratiot, John H. Carotid-body tumors; collective review. *Internat. Abstr. Surg.*, 1943, *77*, 177–186. In *Surg., Gynec. & Obst.*, Sept., 1943.

During the sixty-two years since the first carotid-body tumor was described, not more than 250 cases have been reported. The subject is reviewed and 2 new cases are added.

Gross Anatomy. The human carotid body measures 5 by 3 by 2 mm. It is connected to the carotid bifurcation by a fibrovascular band, the ligament of Mayer. After the age of twenty or thirty years the fibrous stroma increases at the expense of the parenchyma. The arterial supply is from the carotid bifurcation. Nerves are received from the glossopharyngeal and the superior cervical sympathetic ganglion, from the vagus and the hypoglossal.

Embryology—unknown. Boyd believes that this is a dual organ from the mesoderm of the third branchial artery and the ectoderm of the glossopharyngeal nerve.

Function—unknown. These glands are not essential to life or good health. They are not endocrine organs.

Pathology. Carotid-body pathology is confined to that of tumors. Probably from 15 to 20 per cent of carotid-body tumors become malignant. They remain benign for years and then are only locally malignant. Distant metastases are rare. Perhaps they never occur.

Etiology—unknown. Most of the patients are between the ages of twenty-five and sixty years. Both sexes are equally susceptible.

Symptoms. Often the only symptom is the presence of a swelling below and behind the angle of the jaw. Other symptoms are due to pressure on surrounding structures. In a very small number of cases, perhaps 3 per cent, various manifestations of the carotid sinus syndrome occur. (The symptoms attributable to the carotid-sinus syndrome are dizziness, weakness, faintness (usually in the upright position), spots before the eyes, epigastric distress, and unconsciousness.) A tumor is not necessary to

cause this reflex . . . which is produced through the sinus nerve. The reflex proceeds through one of three routes: (1) Vagal route. The symptoms are due to vagus stimulation with cardiac asystole, sino-auricular or auriculoventricular block, and fall in the blood pressure which result in dizziness and faintness. The symptoms are prevented by adrenalin and relieved by atropine. (2) Depressor nerve route. The symptoms are due to vasodilatation with fall in blood pressure and cerebral anoxia. They are relieved by adrenalin. (3) Cerebral type. The impulse goes directly to the medulla and hypothalamus. Atropine and epinephrine are of no benefit.

Differential Diagnosis. (1) Aneurysm of carotid artery; (2) metastatic malignancy; (3) malignant lymphomas; (4) inflammatory lymph nodes; (5) aberrant thyroid tissue; (6) brachial-cleft cysts; (7) branchiogenic carcinoma; (8) thyroglossal duct cysts.—*Mary Frances Vastine.*

Clerf, Louis H., Cooley, E. E., and O'Keefe, J. J. Esophagobronchial fistula. *Surg., Gynec. & Obst.*, Dec., 1943, *77*, 615–617.

Fistulas between the food passages and the tracheobronchial tree have been classified into four main groups:

1. Congenital.
2. Neoplastic.
3. Infectious. The infectious cases may be of syphilitic, tuberculous, or nonspecific origin. The tuberculous type occurs most often in children and is apparently the result of the breaking down of a tuberculous lymph node.
4. Traumatic. These cases are commonly caused by swallowed irregular or pointed foreign bodies, such as bones. The trachea or left main bronchus should be more commonly involved because of their close proximity to the esophagus.

Two patients with esophagobronchial fistula between the right main bronchus and esophagus which existed for nine and thirty-two months, respectively, are reported. No definite cause could be demonstrated although one patient had developed a pulmonary abscess and coughed up a mass of necrotic tissue immediately preceding the development of symptoms. There was no apparent tendency for the fistula to close after the esophagus was placed at rest. Prompt closure of the esophageal end of the fistula resulted following the esophagoscopic application of sodium hydroxide crystal fused on a curved metal applicator and carried into the fistula for a distance of several centimeters. Both patients have been free from symptoms for over eighteen months.—*Mary Frances Vastine.*

Hagens, E. W. Anatomy of the tracheobronchial tree from the bronchoscopic standpoint. *Arch. Otolaryng.*, Nov., 1943, *38*, 469–475.

The author dissected 20 pairs of lungs from cadavers and took measurements which are tabulated in the article. Some general observations were made:

Right Lung

1. While the right lung usually has three lobes, these may be incompletely separated. In five specimens only two lobes occurred. In one specimen four lobes were found, the fourth being a medial or azygos lobe.
2. The right upper lobe bronchus usually divides into three branches. In four specimens there were only two, and in one lung there were four branches.
3. The right middle lobe bronchus is always present even though there is no middle lobe. In the latter case it supplies the lower part of the upper lobe.
4. The right lower lobe bronchus usually branches into (*a*) a dorsal branch coming off immediately, (*b*) a medial branch coming off within a centimeter and (*c*) irregularly placed branches from the main continuation downward.

Left Lung

1. The left lung usually consists of two lobes.
2. The left upper lobe bronchus divides into two branches.
3. The left lower lobe bronchus generally divides into a number of branches. A dorsal branch comes off within a centimeter of the orifice. It supplies the upper part of the left lower lobe. The main continuation after about 2 cm. divides into two rather equal branches. These are separated by an approximately horizontal spur, and they continue downward, one above the other to supply the basal part of the left lower lobe.

The Blood Vessels about the Hilar Region.

1. The aorta crosses anterior to the trachea, just above the bifurcation of the latter,

and after turning down, passes underneath the left main bronchus.

2. The left pulmonary artery, as well as the upper left pulmonary vein just below, cross anteriorly over the left main bronchus. The lower left pulmonary vein courses anteromedially to the left lower lobe bronchus.
3. The right pulmonary artery passes anteriorly across the right main bronchus just below the orifice of the right upper lobe bronchus. As on the left side, the upper pulmonary vein is closely associated with the artery. Adjacent to the right lower lobe bronchus and especially its medial branch is the right lower pulmonary vein. —*Mary Frances Vastine.*

CLEAVER, E. E. Chronic peptic ulceration of oesophagus. *Am. J. Digest. Dis.*, Sept., 1943, *10*, 319–329.

In this series of 10 cases, there were 5 males and 5 females, they were between the age of thirty and seventy-nine years. Pain was a definite symptom in 7 cases. This generally commenced in the lower sternal region, sometimes coming on half to one hour after meals and was relieved by taking food or an alkali. The pain was often described as a burning sensation behind the sternum and was often worse when the patient was lying down. It was sometimes associated with regurgitation of acid mouthfuls. Again the pain might radiate to the back, to both shoulders and sometimes down one or both arms. Pain of a burning character was occasionally felt when patient bent forward. It was not infrequently of the peptic ulcer type, might be present daily for several weeks or months. Pain at first occurs when hard solids are taken; very hot or cold drinks, acids, condiments, etc., frequently produce it. The duration of pain may vary from a few minutes to hours unless relieved by alkalies or antispasmodics.

Dysphagia may be present from the onset of the disease but generally develops after the pain has been present for some months. This symptom is not present until obstruction develops. The obstruction may be due to either spasm or actual stenosis or both. Great distress may be experienced if stenosis is complete and patient is unable to belch gas from the stomach into the esophagus. One of the patients had suffered with choking spells for fifteen years; attacks of dysphagia had been frequent for the past ten years; however, pain had been present for only the past few months.

Hemorrhage is generally not an early symptom but occurs following a long history of pain and dysphagia. Occasionally bright red blood or coffee-colored material is regurgitated; in a later stage, a profuse hemorrhage may occur and may prove fatal. Severe anemia frequently results from a large or repeated small hemorrhages. In this series definite hematemesis occurred in 3 cases, whereas 7 had no hemorrhage.

The roentgenological findings were positive for short esophagus and diaphragmatic hernia in 7 cases. Esophagoscopy was done in 8 cases. In 2 cases biopsy showed ectopic gastric mucosa. One case had both ectopic gastric mucosa and short esophagus associated with a diaphragmatic hernia; the other case showed ectopic gastric mucosa but no short esophagus.—*Franz J. Lust.*

STEIN, GEORGE H. Pneumonic densities obscured by the cardiac shadow. *Radiology*, Dec., 1943, *41*, 576–579.

Roentgenograms of a series of proved pneumonia cases have shown that areas of pneumonic density may be hidden by the heart shadow. The fact that one area of density may be visible does not prove that there are no others, hidden in the heart shadow. Left oblique or left lateral projections may serve to reveal such hidden densities.

Four cases are described and illustrated with roentgenograms showing the location of the obscured densities. In one case there was a pneumonia in the left lower lung field with the mesial part of the spherical consolidation extending behind the heart shadow. This gave a curious half-moon image of the remaining part of the consolidation on the roentgenogram.—*Audrey G. Morgan.*

PAUL, LESTER W. Roentgenologic aspects of acute and chronic esophagitis. *Radiology*, Nov., 1943, *41*, 421–430.

Esophagitis is a common complication of other diseases of the esophagus, such as carcinoma, diverticula, cardiospasm and ulcer. The acute ulcerative form is most commonly seen in association with peptic ulcer, particularly of the duodenum, or after operation for the relief of such ulcers. Chronic esophagitis may be a chronic infection or the fibrous residue of previous infection. Both are uncommon clin-

ically. It is probable that a decided lowering of resistance must occur before acute ulcerative esophagitis can develop. It may be brought about by anything that causes relaxation of the cardia, permitting acid gastric juice to come into contact with the esophageal mucosa. The chief clinical symptoms are substernal pain, dysphagia and hematemesis. The roentgen signs of the acute form are diffuse spasm of the lower esophagus, loss of normal mucosal folds, a fine roughening of the margins and considerable obstruction. In the chronic form the chief roentgen signs are those of diffuse fibrous stricture or in some cases intermittent diffuse spasm of the lower half or third with thickening of the mucosal folds.

Five cases are described and illustrated with roentgenograms.

In the discussion Dr. Templeton said that esophagitis may involve only the mucosa and not the submucosa. In that case the diagnosis cannot be made by roentgen examination. He prefers to use only the anatomical signs for diagnosis, such as thickening of the mucosal folds, shallow ulceration and fissure. He is not sure that the spastic phenomena are diagnostic of esophagitis. It is possible that carcinoma and peptic ulcers of the esophagus are complications of esophagitis rather than esophagitis being a complication of peptic ulcer and carcinoma.—*Audrey G. Morgan.*

Bihss, Francis E., and Berland, Harry I. Roentgenological manifestations of pleuropulmonary involvement in tularemia. *Radiology*, Nov., 1943, *41*, 431–437.

The authors discuss 81 cases of tularemia seen by them in 36 of which there were chest symptoms. In 29 of these roentgenograms of the chest were made. The cases are divided into two groups: 72 of the ulceroglandular, glandular and oculoglandular types and 9 of the typhoid type. Of the 72 cases in the first group, 27 had symptoms or physical signs referable to the chest. In 19 there was roentgen evidence of pleuropulmonary involvement beginning with hilar adenopathy followed by retrograde extension through the lymphatics into the lung parenchyma or even into the pleura, resulting in effusion. In this group of 19 cases there were 4 deaths, while in the 53 cases that did not show pulmonary lesions there was only 1 death from septicemia. In the second group of 9 cases of typhoid tularemia all had signs of lung involvement. These showed involvement of the parenchyma resembling that of pneumonia and the hilar nodes were generally not enlarged. Seven of these patients had pneumonia, in 1 case complicated by abscess formation. Three of these 7 patients died.

Nine cases illustrative of these two types of lung involvement in tularemia are described and illustrated with roentgenograms.—*Audrey G. Morgan.*

ABDOMEN

Vinson, Porter P. Treatment of dysphagia from hernia through esophageal hiatus in diaphragm. *Arch. Otolaryng*, July, 1943, *38*, 27–31.

There are two types of diaphragmatic hernia in which dysphagia is often the predominating symptom. One of these is the para-esophageal hernia and the other is the short esophageal hernia.

The author has seen 53 diaphragmatic hernias over the past six years. Of these, 11 were para-esophageal, 3 in men and 8 in women. Forty-two had short esophageal hernias and of these, 18 were in men and 24 in women. All the patients were more than forty years of age. The difficulty in swallowing was more pronounced in those with the short esophageal type. In this type dysphagia results from spasm or stricture at the junction of the esophagus and the hernial sac. In persons with hernia of the para-esophageal type it results from stricture in the lower portion of the esophagus, spasm at the cardia or pressure from the herniated portion of the stomach on the lower part of the esophagus. It is hard to explain why, in the patients who have congenital shortening of the esophagus, there is seldom dysphagia before forty years of age although the deformity has presumably been present since birth.

The signs and symptoms of diaphragmatic hernias (the para-esophageal and short esophagus hernias) which may be noted include:

1. Intermittent dysphagia observed on swallowing any type of food, solid or liquid.
2. Constant fear of choking.
3. Complete esophageal obstruction from a bolus of meat (for example) may occur.
4. Bleeding may take place as the result of ulceration at the junction of the esophagus and the hernial sac.
5. Cicatrical stricture may occur as the result of recurring ulceration and healing.

(When cicatrical stricture is present in diaphragmatic hernia, the resultant dysphagia is indistinguishable from benign stricture from other causes.)

6. Gaseous distention especially after meals and when the patient is lying down at night. The degree of distress usually depends on the size of the hernial sac and is therefore more pronounced in patients with para-esophageal hernia.
7. Epigastric and substernal pain which may be indistinguishable from that of coronary disease, cardiospasm or gallbladder colic pain.
8. Severe anemia may occur. The bleeding may be prolonged oozing or it may be a sudden severe hemorrhage.

As for treatment, operation is the most satisfactory procedure in the para-esophageal type of hernia. For patients with congenital shortening of the esophagus with hernia, operation is not satisfactory. Passage of dilating sounds over a previously swallowed silk thread will provide satisfactory results.—*Mary Frances Vastine.*

JENKINSON, E. L., and LATTEIER, K. K. Nonorganic gastric filling defects simulating carcinoma. *Radiology*, Nov., 1943, *41*, 444–450.

Two cases are described and illustrated in which roentgen examination showed filling defects seemingly those of carcinoma. On the basis of the findings operation was performed and no abnormality found. Even sections removed for microscopic examination showed nothing abnormal. It was decided that the findings had been caused by spasm which had not been relieved by the administration of atropine. It is quite true that changes similar to those of carcinoma may be caused by spasm. Deformities involving only the walls of the stomach may be due to spasm. It has been believed that spasm of the pyloric antrum looks smooth and narrow on roentgen examination but this was not so in these cases. If an absolutely reliable antispasmodic could be found it would greatly aid diagnosis in such cases. The qualities of various antispasmodics are discussed.

While the authors accept the pathologist's report they still think this spasm may be an early manifestation of some lesion that may later prove more serious. In the discussion several of the discussants agreed with this view.—*Audrey G. Morgan.*

STEIGMANN, FREDERICK. Considerations on the diagnosis of large gastric ulcers and implications as to treatment. *Am. J. Digest. Dis.*, March, 1943, *10*, 88–93.

It is evident that large gastric ulcers are significantly more often malignant than are smaller lesions. The hazards confronting the clinician, roentgenologist, and gastroscopist in the differential diagnosis of large gastric ulcers are great and this fact needs to be re-emphasized. The results of this study of large gastric ulcers, extending over a period of ten years, support similar previous reports showing that there is nothing in the history, physical examination, laboratory tests, findings on roentgen study, gastroscopy, or in the results of medical treatment which will unfailingly differentiate a benign from a malignant gastric ulcer. In some cases only the histopathologic examination of the excised lesion will lead to correct diagnosis.

The therapeutic implications of the foregoing considerations would seem to be clear. To the author, as to many others, the observations here reported suggest the advisability of resecting every large gastric ulcer. As pointed out in a previous paper, resection of large gastric ulcers is advisable not only because of the danger of misdiagnosing a malignant lesion as benign, but also because the complications of these large gastric ulcers make them in a way malignant when they are histopathologically benign. Surgery is advised by the author for large gastric ulcers even though he is aware of Bloomfield's conclusion that errors in differential diagnosis do not exceed the mortality rate of resection. This conclusion seems inapplicable to the clinic where he works where the mortality from operations is not high.

For years the author followed the plan of closely observing his patients with large gastric ulcers until the lesion was completely healed. The results, however, were not entirely satisfactory inasmuch as even when the lesion was not malignant, he frequently saw recurrences and complications after apparent complete healing and finally he often had to operate. From such observations, he would hesitate to say that there is such a thing as complete healing of a large gastric ulcer on medical treatment. The excellent paper by Palmer and his associates supports this view. Considering, therefore, the complications that may arise from large gastric ulcers, even when they are benign, and the possibility that they may be carcino-

matous, it seems to him that one can never rest content until such a lesion is resected.—*Franz J. Lust.*

Pearl, Felix L., and Brunn, Harold. Multiple gastric polyposis. *Surg., Gynec. & Obst.*, March, 1943, *76*, 257–281.

This report is an analysis of 41 cases of gastric polyposis having 3 or more polyps. It is supplementary to a previous report of 84 cases published by Brunn and Pearl in 1926. The report is high-lighted in the summary:

1. Multiple gastric polyposis may be congenital (or neoplastic) or inflammatory (or hyperplastic). The condition of multiple gastric polyposis stops abruptly at the duodenum.
2. The symptoms are not characteristic. In the series, epigastric pain and tenderness were most frequent. In over half of the cases bleeding was found to take place in the vomitus, stool, or gastric content. Pedunculated tumors and those near the pylorus are more apt to give symptoms of separation of polyps or pyloric obstruction. Some patients have had symptoms over twenty years.
3. The roentgenogram may fail to differentiate multiple polyposis from chronic hypertrophic gastritis, retained food, bezoar or sarcoma. The correct diagnosis was made most often by roentgen examination and by operation, but the condition was often overlooked by the roentgenologist. In the 41 cases, the correct diagnosis was made by roentgen examination in 17, by operation in 13, by examination of the excised surgical specimen in 5, and by autopsy in 6.
4. Gastroscopy is a valuable aid in the diagnosis of gastropathies especially in the differentiation between benign and malignant lesions and between polyposis and hypertrophic gastritis.
5. Free hydrochloric acid was absent from the gastric contents in almost every case.
6. Of the 41 cases, 4 gave no malignancy data. Of the remaining 37, malignant alteration was found in 19. This argues for radical surgical removal of the tumor-bearing area by gastric resection as soon as the diagnosis is made.—*Mary Frances Vastine.*

Melamed, A., and Hiller, Robert I. Prolapsed gastric mucosa; roentgenologic demonstration of ulcer crater in prolapsed polypoid mucosa. *Am. J. Digest. Dis.*, March, 1943, *10*, 93–95.

A case of prolapsed polypoid gastric mucosa, visualized by roentgen examination and verified by surgery, is presented. Severe melena arising from two ulcers on the prolapsing mucosa was the outstanding symptom. At least one of the ulcers was demonstrable on the roentgenograms.—*Franz J. Lust.*

Smith, Lucian A., and River, Andrew B. Gastroileostomy and gastroileal ulcer. *Surg., Gynec., & Obst.*, Jan, 1943, *76*, 110–114.

A complication which may follow gastroenterostomy is a stoma which is gastroileal instead of gastrojejunal. This low anastomosis is the result of a surgical error. At the Mayo Clinic approximately one diagnosis of this condition is made in each one to two years. Roentgenological examination is of the greatest value in making the diagnosis.

In this paper, 9 cases of gastroileostomy are reported. The symptoms of gastroileostomy are discussed. They include:

1. Diarrhea which characteristically begins soon after operation and often is lienteric in type.
2. Vomiting which occasionally has a fecal quality.
3. Loss of weight which varies with the severity of the diarrhea.
4. Pain of the bowel type when unmixed with that of gastroileitis or gastoileal ulcer. This type of pain is lower abdominal and cramping with relief on passage of flatus, stool, or an enema. Gastroileitis and gastroileal ulcers may simulate gastrojejunal ulcer clinically. They are present only when the concentration of free acid is significant. Gastroileitis was present in 1 case and gastroileal ulcer in 3 cases of the series reported.—*Mary Frances Vastine.*

Brown, Samuel, McCarthy, J. E., and Fine, Archie. The roentgen diagnosis of biliary tract tumors. *Radiology*, Nov., 1943, *41*, 459–463.

The word tumor as used here applies to all enlargements, inflammatory, non-inflammatory or neoplastic. In roentgen examination a fluoro-

scopic inspection should first be made of the chest, and then a general survey of the abdomen with plain roentgenograms and, third, a study of the gastrointestinal tract for possible changes produced by pressure.

One of the most frequent findings is elevation of the diaphragm on the right side due to enlarged liver, subphrenic abscess, phrenic paralysis, atelectasis or eventration. If the cause of the elevation is not known the diagnosis can generally be established by examination of the stomach and intestines with a barium meal and enema. In enlargement of the liver the stomach and duodenum are displaced to the left and backward and the colon downwards. In all of the other conditions the stomach and colon are usually pulled upward in the same direction as the liver.

In taking the plain views of the abdomen, in addition to anteroposterior and lateral views, a left anterior oblique view should be used to separate the shadow of the right kidney from a superimposed shadow of an enlarged gallbladder.

In the roentgen diagnosis of tumors of the common duct it is necessary to have an accurate knowledge of the exact relationship between the gallbladder, ducts, pancreas and duodenum. There may be defects in the lumen of the duodenum at or just beyond the superior angle due to pressure from dilatation of the neck of the gallbladder, the cystic or common duct, caused by obstruction by a stone or tumor. The most satisfactory view for demonstrating a pressure defect in the duodenum is the right lateral or right anterior oblique with the patient lying on the horizontal fluoroscope.

Roentgenograms are given showing the different forms of tumors of the liver, gallbladder and extrabiliary tract.—*Audrey G. Morgan.*

BRUNSCHWIG, ALEXANDER, and TEMPLETON, FREDERIC E. Roentgenographic diagnosis of neoplasms of the peri-ampullary region and head of the pancreas. *Radiology*, Nov., 1943, *41*, 438–443.

As carcinomas of the head of the pancreas and of the ampulla of Vater can be totally excised, together with the duodenum, it is very important to be able to make an early roentgen diagnosis of such tumors. Peri-ampullar tumors can be seen more readily than those of the head of the pancreas as the latter sometimes do not make changes in the outline of the duodenal curvature.

Ampullar carcinomas may be polypoid and protrude into the lumen of the duodenum, in which case they are readily recognizable. A tumor inside the ampulla expands it and gives the picture of a smooth, enlarged papilla of Vater. These are sometimes not detected because of inability to produce marked distention of the duodenum by barium. Ampullar carcinomas may also show flattened ulcerations with raised rolled edges. Extensive infiltration of the wall of the duodenum by carcinoma of the ampulla or carcinoma primary in the second portion of the duodenum causes great distortion of the wall and rigidity of the involved segment, and should be easily detected. In these cases the normal mucosal markings are replaced by irregular coarse markings and polypoid masses may protrude into the lumen. Even in such advanced cases operation may be possible. Frostberg's reversed 3 (ε) sign indicates edema of the papilla resulting from tumor in or near the ampulla. It is of great value when positive but of little or none when negative. But all of the signs of carcinoma of the ampulla may be present and there may be no tumor.

As mentioned before, small carcinomas of the head of the pancreas may show no signs of distortion of the duodenum but such small tumors in the periphery of the head may invade the duodenum and cause areas of rigidity or even ulcerations. These different types of carcinoma are illustrated with roentgenograms.

But even if there is no roentgen evidence of tumor, exploratory operation should be performed if there is the clinical picture of obstructive icterus, unassociated with typical gallstone colic and possibly accompanied by an enlarged, distended and palpable gallbladder. Nor should laparotomy be refused because there is roentgen evidence of extensive involvement of the duodenum, as the resection of even large tumors in this region will give some palliation to the patient whose average length of life without treatment is but six or eight months.—*Audrey G. Morgan.*

GILE, JOHN F., and MACCARTY, WM. C., JR. Calcified concretions within a Meckel's diverticulum. *Radiology*, Nov., 1943, *41*, 491–494.

Calcification in appendiceal concretions dense enough to cause a shadow on the roentgenogram have been described before but so far as the authors know no case has been described in the American literature in which calcified con-

cretions in a Meckel's diverticulum were demonstrated surgically. Such a case is described in a white man, aged thirty-four, who complained of nausea, vomiting and abdominal pain. The clinical impression was that of acute intestinal obstruction. A roentgenogram showed multiple distended loops of small bowel with an abnormal amount of gas in the colon. There were two irregular areas of calcification in the right lower abdomen which were thought to be calcified lymph nodes. Exploratory laparotomy was performed and showed a Meckel's diverticulum arising about 20 inches above the ileocecal valve which ran down freely without a mesentery to the right pelvic wall. At this point the distal end was attached to the tip of the appendix. The diverticulum and the appendix formed a band behind which a loop of ileum had become lodged and obstructed. It is believed that appendicitis with adhesions and rupture into the diverticulum laid the foundation for the resultant intestinal obstruction.

Drawings of the specimen are given.—*Audrey G. Morgan.*

Mulsow, F. W. Meckel's diverticulum containing calculi. *Am. J. Digest. Dis.*, May, 1943, *10*, 188–189.

Reports of calculi in Meckel's diverticulum are very rare. Only 9 previous reports could be found, yet it has been estimated by various authors that 1 to 2 per cent of the population have a Meckel's diverticulum. There are many reports in the literature of cases, yet only 2 cases of calculi in it could be found in the American literature. Such calculi when seen in roentgen examinations might be mistaken for calcified lymph nodes, renal calculi or phleboliths. These stones have the appearance of gallstones in a few instances. It appears, however, that by proper physical and chemical examinations they can be distinguished from gallstones. In the present case the stones were obviously formed in the diverticulum. The association of an acute appendix with the acute diverticulitis or other acute abdominal conditions is not unexpected, and in the reported instance reveals the value of a thorough exploration where possible in acute abdominal conditions. *Franz J. Lust.*

Kennedy, Roger L. J., Dixon, Claude F., and Weber, Harry M. Polypoid lesions of the colon of children. *Surg., Gynec. & Obst.*, Dec., 1943, *77*, 639–644.

This paper is based on the study of 11 cases of polypoid lesions of the colon. In all of these cases the patients were children and the colonic lesions were situated beyond the reach of the sigmoidoscope.

Symptoms.

1. Blood in the stools was the outstanding symptom.
2. Small amounts of clear or blood-tinged mucus were observed in 5 cases.
3. Pain was not a prominent symptom.
4. Diarrhea was present in only 1 case.
5. Polypoid lesions of the colon were frequently associated with similar lesions of the rectum.

Diagnosis.

1. The blood is bright red indicating that the source of the bleeding is in the lower part of the gastrointestinal tract, certainly below the ileocecal valve.
2. The blood is usually on the outside of the stool and is not mixed with it as is usually the case in which the bleeding is due to lesions of the small intestine, such as Meckel's diverticulum.
3. The bleeding is not associated with diarrhea.
4. Patients who have polypoid lesions of the colon are usually well nourished.

Proctosigmoidoscopy.

1. In 6 of the 11 cases, polypoid lesions also were present in the rectum.

Roentgenologic Examination.

1. The large intestine of the child is of proportionally greater length and caliber than is that of an adult. Castor oil seems the best agent to use in children for the purpose of preparing the large intestine for roentgenologic examination as it does not exaggerate this disproportion in length and caliber. Fifteen cubic centimeters is given to infants and 30 cc. to older children the night before the examination. A simple enema is given the morning of the examination.
2. The opaque enema is given as rapidly as possible as the child is apt to become unruly if the examination is prolonged. Sedation (with barbiturates) is sometimes necessary. A double contrast enema is always obtained.

Treatment.

The treatment of polypoid lesions of the colon

consists of transcolonic excision of the lesions or resection of the involved segment of the colon.

Pathologic Changes.

In 9 of the 11 cases, microscopic examination disclosed that the lesion was an adenocarcinoma, Grade 1 or low Grade 1. In the 2 remaining cases, the lesion was classified as an adenoma. Although polypoid lesions may be lipomatous, fibromatous, or angiomatous, the authors have never observed such lesions in the colon of children.—*Mary Frances Vastine.*

GERWIG, W. H., JR., and STONE, HARVEY B. Enteric intussusception in adults. *Surg., Gynec. & Obst.*, Jan., 1943, *76*, 95–99.

Acute enteric intussusception in the adult is an entity that is encountered only occasionally. Polyps in the colon are quite common and their occurrence in the small intestine is rather rare, but a combination of polyps in both the large and small bowel is most unusual. A case is reported of an acute jejunal intussusception occurring in an adult in whom multiple polyps of both the large and small intestine were later found. Four weeks following the operation for intussusception a barium enema examination was done. The polyps in the large bowel were seen only when the double contrast study was made following evacuation of the barium.

In this paper, intussusception is thoroughly discussed as to:

1. Definition, classification, mechanism and etiology.
   a. The primary or acute type occurs chiefly in infants at the ileocecal region. An underlying lesion is seldom found in these cases and once reduced it seldom recurs.
   b. The secondary or chronic recurring type usually occurs in adults or older children and an organic causative factor is frequently present. In the large bowel, the chief offender is the malignant tumor while in the small intestine benign neoplasms (especially the adenomatous polyps and lipomas) are most often encountered as etiological factors. Any tumor of the intestines is a potential cause of intussusception and unless there is a definite contraindication it should be removed. This is especially true if the growth is an adenomatous polyp for these polyps tend to undergo malignant change. Lawrence has reported 232 autopsy findings of polyps of the gastrointestinal tract with malignant transformation in from 6 to 7 per cent. It is in the descending colon, sigmoid and rectum that polyps bear the closest relationship to malignancy.
2. Symptomatology.
   a. Primary type—young healthy infant suddenly begins to have colic-like pain, passes blood from rectum, develops an abdominal mass and shows signs of intestinal obstruction.
   b. Secondary type—occurs in an adult who may present varied symptoms and in whom a preoperative diagnosis of intestinal obstruction is usually made. The picture is that of high obstruction if in the small bowel and of slower low obstruction if in the large bowel. Bleeding from the rectum is seldom encountered. There is usually a history of irregular attacks of colic-like pain.
3. Treatment.
   Surgery—reduction in the primary form; reduction or resection in the secondary form.—*Mary Frances Vastine.*

MAYORAL, A. Motor changes observed fluoroscopically in the colon of a patient afflicted with a tumor in the hypothalamic region. *Am. J. Digest. Dis.*, Aug., 1943, *10*, 305–307.

The author describes his observations in a case of a brain tumor (astroblastoma) of the right gyrus hippocampus with massive hemorrhage. The roentgenological examination of the upper gastrointestinal tract failed to show any pathologic condition; however, no barium was seen in the colon at the six hour examination. The findings of the author during the barium enema were the following: "During fluoroscopic observation, great difficulty was encountered in filling the descending colon, the progress of the opaque media was very slow due to marked spasticity. When the head of the column reached the mid-transverse colon propulsive motility became very active, barium was squeezed out of the lumen toward the anus. After 20 to 40 seconds the colon would calm sufficiently to allow further progress of the enema. Each advance, however, was met with further

and similar propulsive movements of the gut. The contractions were very forcible and complete. No barium remained in the portion of the intestine showing contraction except for a few flecks attached to the mucosa. In about 30 seconds these explosive movements would subside sufficiently to allow some barium to advance in the intestines. . . . the proximal portion of the colon was finally filled, but at no time during the period of examination, that lasted about five or six minutes, did the colon show complete relaxation. The movements of the colon were like those seen in cecal tuberculosis."

Two weeks later another barium enema examination was made. At this time no abnormality was found except for a localized area of what appeared to be thickened mucosa at the cecum.

Repeated stool examinations were negative for occult blood and amoeba. There were no signs of tuberculosis. At autopsy the gastrointestinal tract was found to be normal.—*Franz J. Lust.*

Golob, Meyer. The merits of sigmoidoscopy preceding a barium enema. *Am. J. Digest. Dis.*, May, 1943, *10*, 182–184.

Golob describes a case of an adenocarcinoma of the rectosigmoid. Sigmoidoscopy was able to detect the tumor, whereas the roentgenological examination was not able to visualize the lesion. Canalization was noted while the barium enema was administered. The post evacuation roentgenogram might have given a hint that there was a tumor present. Golob emphasizes the importance of the direct examination in conjunction with all roentgenological examinations of the colon.—*Franz J. Lust.*

Probstein, J. G. and Senturia, H. R. Volvulus of the sigmoid colon. *Surg., Gynec. & Obst.*, Dec., 1943, *77*, 669–672.

The occurrence of volvulus in this country is relatively infrequent. By contrast, sigmoid volvulus occurring as an acute abdominal emergency is very common in Russia and Germany. The frequency of redundant colons is attributed by most authors to a coarse vegetable diet rich in undigestible cellulose which makes a great demand on the pelvic colon as a fecal storehouse.

Two cases of volvulus of the sigmoid colon are reported. In 1 of the cases, hepatodiaphragmatic interposition of the colon was present in addition to a volvulus of the megasigmoid, two relatively uncommon and usually distinct conditions.

The roentgenologic findings in hepatodiaphragmatic interposition of the colon (or hepatoptosis) were first described by Béclère in 1899 who wrongly interpreted the findings as those of a subphrenic abscess.

In their discussion of the cases presented the authors bring out the following points:

1. Volvulus may occur in the sigmoid-cecum and in the small intestine. The most common site is the sigmoid.
2. The symptoms of volvulus simulate closely the findings of other obstructive lesions of the colon or small intestine depending on the acuteness or chronicity.
3. Volvulus of the sigmoid shows a decided tendency to recur.
4. Untwisting the bowel in a case of volvulus accomplishes nothing toward removing the predisposing or etiological factors.
5. Since shortening of the mesentery, sigmoidopexy, and other procedures have not produced satisfactory results, it is the authors' opinion that an immediate obstructive resection should be attempted at the primary exploration if it is possible. —*Mary Frances Vastine.*

Metheny, David, and Nichols, H. E. Volvulus of the sigmoid. *Surg., Gynec. & Obst.*, Feb., 1943, *76*, 239–246.

Volvulus of the sigmoid occurs when the sigmoid is so redundant and the mesentery so relaxed as to permit a twisting of this part of the gut. The obstruction may be partial, complete, or strangulated. Clinically significant redundancy of the gut may be congenital or acquired. Too much sigmoid may be a congenital abnormality. The authors believe that redundancy may be increased over a period of years to the point where it will cause strangulated volvulus. The symptoms include:

1. Attacks of partial obstruction of the colon at first. Obstipation for a day is followed by a more or less distended abdomen and gas pains below the navel.
2. Tenderness on the left side.
3. Occasionally the redundant sigmoid may be palpated above the navel on the left side. It seems like a phantom cyst that disappears as it is being examined.
4. When a patient has learned that an enema,

especially one taken in the knee-chest position, will produce relief, recurrent volvulus of the sigmoid should be suspected.

Since one-third of all patients having barium enemas show some redundancy of the sigmoid, the roentgenologist is not justified in making the diagnosis before obstruction occurs. The incidence of recurrent volvulus of the sigmoid is more common than the diagnosis. It has been estimated that volvulus in this region accounts for 15 per cent of intestinal obstructions. In the King County Hospital, Seattle, Washington, from 1934 to 1941, 496 patients with intestinal obstruction were admitted. Of these cases 5 were due to volvulus of the sigmoid. The authors report these 5 cases in detail.—*Mary Frances Vastine.*

HEILBRUN, NORMAN. Roentgen evidence suggesting enterocolitis associated with prolonged cathartic abuse. *Radiology*, Nov., 1943, *41*, 486–491.

A case is described in a white woman thirty-six years of age in which there were extensive changes in the lower part of the small bowel and throughout the large bowel. The roentgen findings were those of ileitis and colitis. The article is illustrated with roentgenograms showing the changes. The patient had none of the clinical signs of these diseases and the only factor that could be found which seemed to explain them was that for twenty years the woman had been stubbornly constipated and had taken irritant cathartics daily throughout that period. The roentgen findings improved markedly as soon as the use of these irritant drugs was stopped.—*Audrey G. Morgan.*

GYNECOLOGY AND OBSTETRICS

THOMS, HERBERT. Roentgen pelvimetry; a commentary. *Surg., Gynec. & Obst.*, Aug., 1943, *77*, 153–156.

Because of the definite clinical significance of variations in the bony pelvis, the experience of the writer has led him to recommend that all primigravid women should have the benefit of the roentgen survey of the pelvis. During the past seven years, 2,000 patients have been so surveyed in the author's clinic. The comments made include:

1. The two pelvic views used are the inlet and lateral ones. A 36 inch target-film distance is used so that distortion is minimized.

2. *The inlet view* is taken with the patient semirecumbent, using a back rest and centering the target 6 cm. posterior to the upper symphysial border. The pelvic inlet is made parallel to the film by measuring vertically the distance from the table top to a point 1.5 cm. below the upper symphysial border on its anterior surface and measuring vertically the distance from the table top to the interspace posteriorly between the fourth and fifth lumbar vertebrae. The patient's position must be such that these two points are equidistant from the table top, for they establish the level of the pelvic inlet.

The lateral view is taken with the patient standing in the lateral position, the target being centered at the upper edge of the acetabulum. The correction of distortion in both views is made with an isometric rule introduced in the plane to be measured. In the inlet view this is done by a double exposure and in the lateral view this scale is projected at the one exposure.

3. It has been found that an allowance for each patient of fifteen to twenty minutes is sufficient for the roentgen study. The inlet view is taken on an 8 by 10 inch film and the lateral on an 11 by 14 inch film.

4. Pelvic outlet views are not included in the roentgen survey as roentgen methods are not too satisfactory for accurate measurements in this portion of the pelvis and the usual palpatory methods are adequate for both mensuration and for determining the important contours.—*Mary Francis Vastine.*

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JUL 1 2 1945

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]

The AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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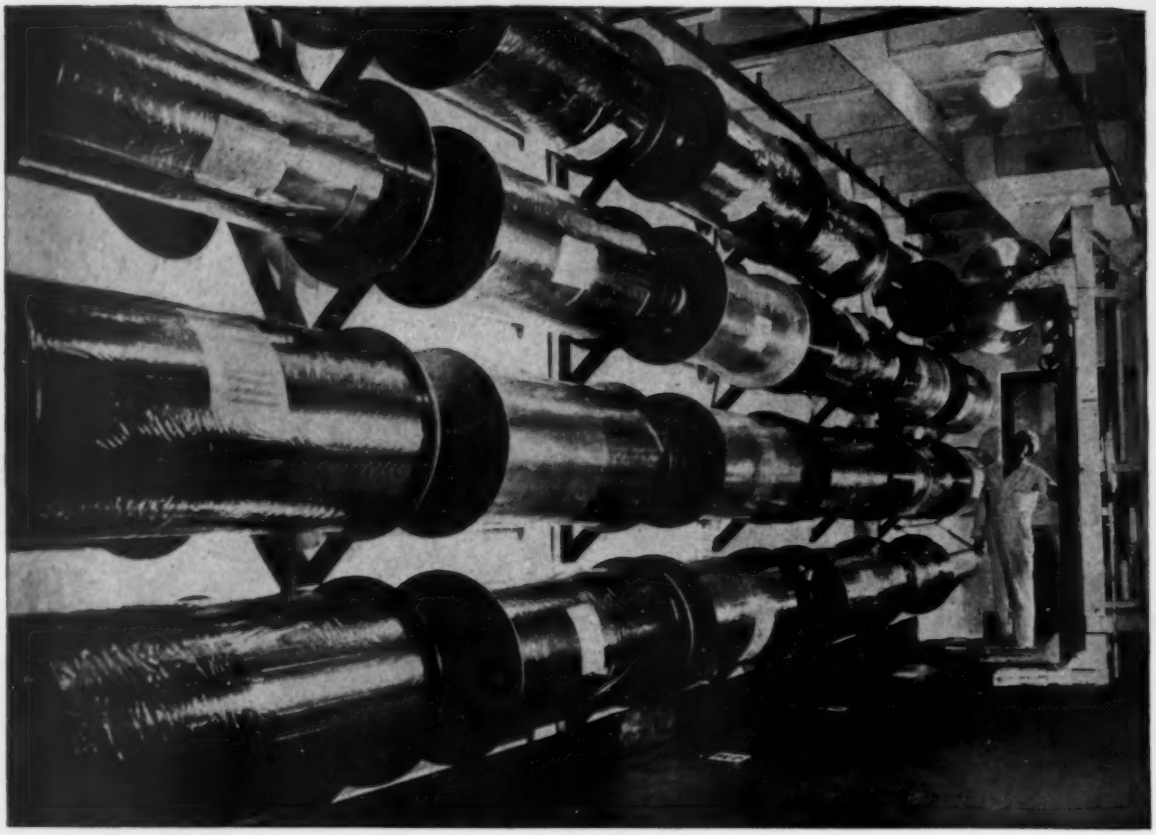

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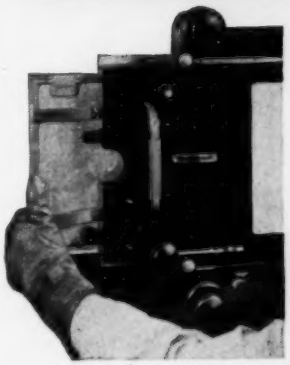

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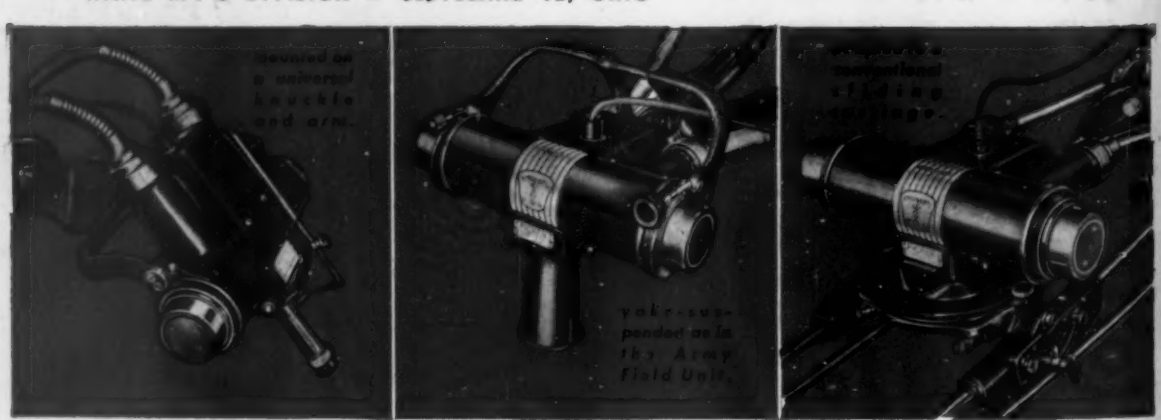
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